MARCH 24, 1958

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Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN
RESEARCH AND DEVELOPMENT

R ESEARCH
and news edition
D EVELOPMENT

Can we DESIGN World Weather?...

see page 23

THE TRANSLATING MACHINE

an ABC for you

see page 30

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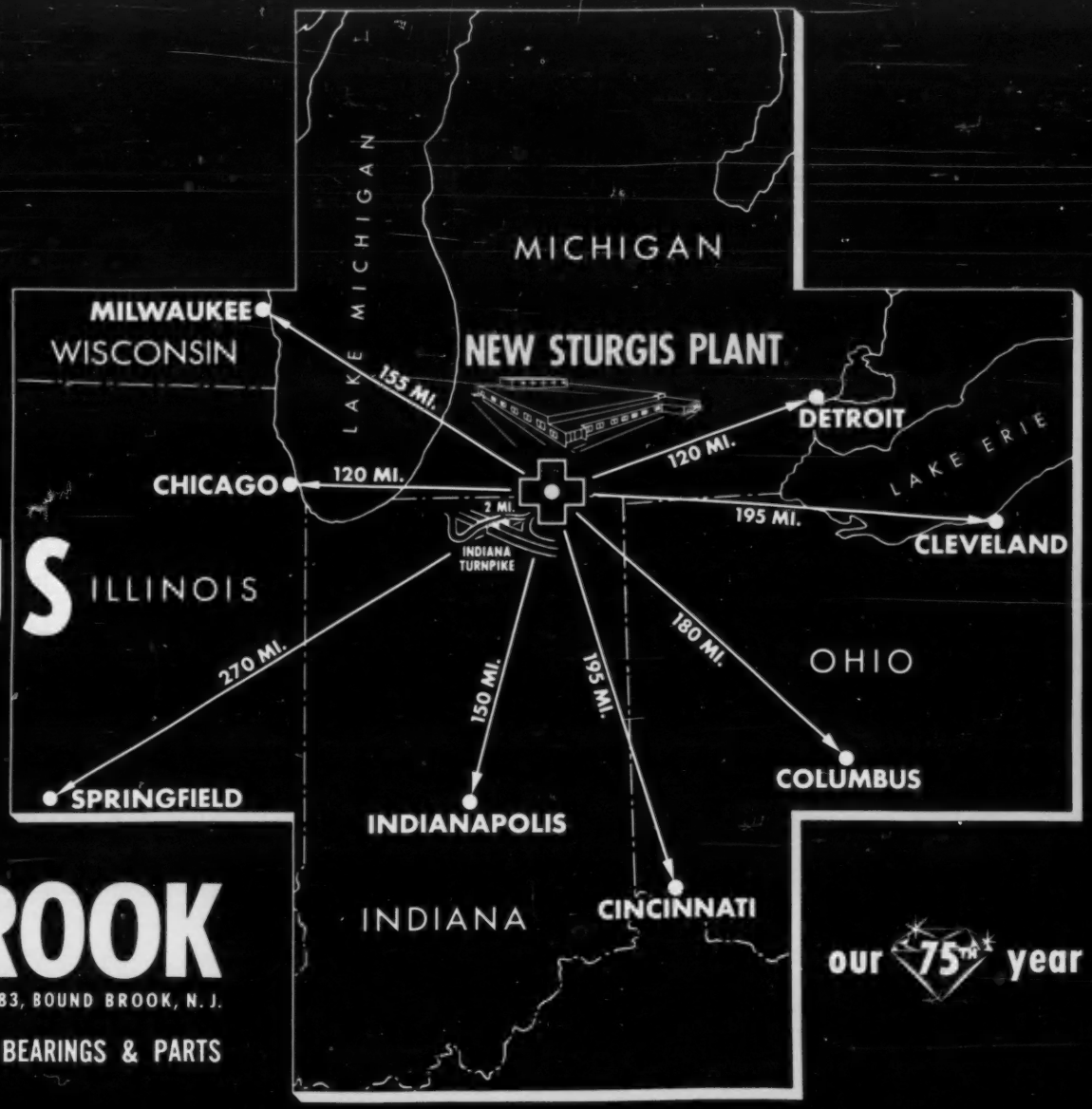

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This 2-part issue includes a **separate** 16-page section on the **Design Conference and Show Program** with digest of papers, the Conference details, list of exhibitors and floor plan of the Show, a Loop-area map and an eating guide for Chicago.

In addition, a special report **The Engineer Comes Into His Own** Twelve feature articles, each examining the new, more-responsible role of the engineer in a changing society.

- What is the status of engineering education, both undergraduate and graduate?
- How is industry encouraging high-school students as well as working engineers?
- How is the Federal government helping and hindering research, development and design?
- What does the engineer need to know about people, politics, economics, the social sciences— to be a better human being and a better engineer?

Don't miss* both *sections of next week's
Product Engineering

IN ADDITION the March 31 issue includes:

Thermal radiation from hot surfaces.
How to calculate losses and pick surfaces and temperature levels for fast heat dissipation.

Which plastic for abrasion resistance?
A table of specific characteristics of plastics that resist abrasion best.

Smaller, better-controlled dc motors.
Shell construction allows integral water cooling, control with thyratrons and magnetic amplifiers.

How to plot and read a carpet curve.
Formulas involving three variables plotted on a chart allowing quick interpolation.

Automatic assembly.
A check chart for single-part complexity can guide design—reveal total complexity.

NEW COMPONENTS and MATERIALS

CATALOGS and BULLETINS

All of the products and publications reviewed in this coming Design Show Issue are being announced or first made available at the 1958 Design Engineering Show. Each review will include the booth number of the exhibitor; additional data on each new product and copies of the literature reviewed will be obtainable as usual through the Reader Service Card.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

RESEARCH and DEVELOPMENT news edition

March 24, 1958 Vol. 29, No. 12

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Product Engineering ..... SIDELIGHTS

RESEARCH and DEVELOPMENT news edition

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●**Most of the world** accepts bad weather philosophically and adjusts plans to suit—but not New Yorkers. Here every raindrop is a personal affront; every snowflake was obviously shaped by a malignant fate; each sunless summer day is cursed by these gray-faced cave dwellers, who carefully draw the blinds when sunhine threatens to fade a rug. Only a New Yorker would have the temerity to suggest changing the weather in the first place (p. 23)—but now who is going to decide what to change it to?

●**Jointed buses** used in the Netherlands (p. 36) are far from the first of their kind. Early American trolleys were of similar design but were dropped in favor of individual cars run more frequently. The problem was similar to that of the earthworm who poked his head out of the sand and noticed another worm nearby. "How's the eating over there?" he asked. "Shut up, you fool!" was the reply, "I'm your other end."

●**Junior rocketeers** (p. 25) have been sending their designs and problems to the Army for comment. Some are complex, multistage affairs but the neatest consists of one nut, two bolts and a kitchen match head. You screw one bolt in part way, insert the match head and close the opening with the second bolt. Three heads were inserted by one 13-year-old "for a real loud noise." He put it in a vise and started to tighten with a wrench. ". . . it all of a sudden went off with a big noise, and went through the cellar window, and took a big chip out of our cement step. . . ." Now **there's** action (or reaction) for you.

●**Translation machines** require a highbrow mathematics of language to operate even reasonably well (p. 30), but humans can be made into effective translators with much less trouble. We know of one high-school kid who, for some reason, just couldn't get anywhere with his Spanish lessons. Much to his father's disgust the teachers suggested he drop the course. "No aptitude," they said. "Nonsense," said the father, "You teach him in school; I'll beat him at home. He'll learn."

ABP MARCH 24, 1958 **Product Engineering** *A McGRAW-HILL PUBLICATION* Vol. 29, No. 12 ABC

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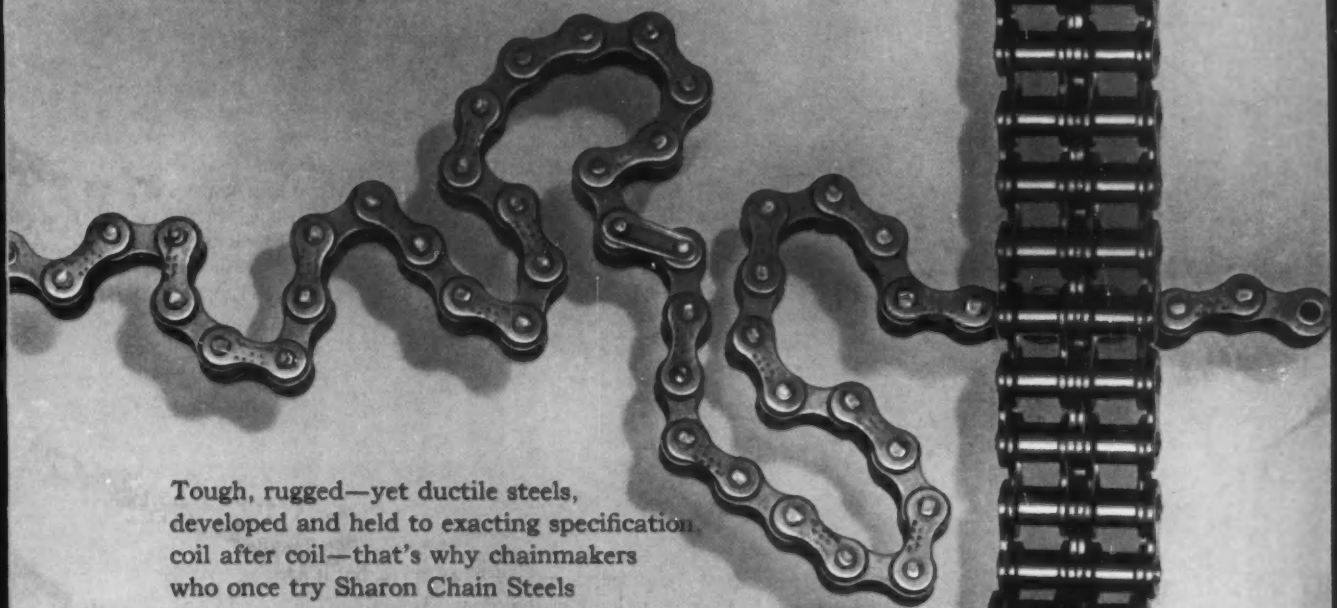

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READER TO EDITOR

Built-in Vacuum System

To the Editor:

Referring to your "Why Don't They R & D" section, (*PE*—Jan. 27, p. 58) I noticed a suggestion by K. Kahn for a built-in vacuum system. H-P Products of Louisville, Ohio has been building such a system for years although it is a dry system. I myself designed a wet system which is very effective. Fortunately, in my case, I can let the refuse exhaust in a field. However, I am certain a standard water closet with a sealed top could be adapted for flushing the refuse in a drain.

If anyone is interested in such a project for his own use, I will be glad to give him what help I can.

—Paul A. Klann
Klann Organ Supply Co., Waynesboro, Va.

Wheel Balancer

To the Editor:

Your Feb. 10 issue included comments by Mr. H. J. Brikowski regarding an automatic wheel balancer. There is in existence such a device, invented by a Mr. Wilbur Leopold, which is able to adjust wheel unbalance automatically and continuously during driving.

This device consists of a toroidal tubular element having specially constructed and movable weights therein, which element can be secured inside a wheel cover. The device is the subject of a US patent application on which a number of patent claims have already been allowed.

—Campbell Pilcher
Upper Montclair, N. J.

Military Bright Spots

To the Editor:

The article entitled, "Red Tape Worm in the Desert" (Jan. 27, p. 23) was in sharp contrast to our reasons for helping with the article. We believe that our organization represents a unique and very effective method for handling military research development. The Bureau of Ordnance has been very farsighted in giving its field stations unusual freedom. This freedom has produced effective workable designs for new weapons. This policy is in sharp contrast to some of the confusion inherent in other methods of doing military research where adequate technical competence is not available in the government.

We believe the organization at this Station works to diminish the lack of understanding which can develop between industry and the government in those development areas where clear specifications are not possible. Some bright spots do exist in our military program. —William B. McLean
Technical Director
U. S. Naval Ordnance Test Station
China Lake, Calif.

Timing Belt

To the Editor:

In your issue of Feb. 10, under the title "Why Don't They Research & Develop," Mr. E. A. Kremeyer requests a timing belt which will permit the driving of sprockets on both sides of the belt, thereby permitting the sprockets to revolve in opposite directions.

We respectfully submit our roller chain catalog, which we hope will explain how roller chain will perform the way Mr. E. A. Kremeyer wishes.

—Michael R. Conner
Chief Metallurgist
Atlas Chain & Manufacturing Co.

Punch Card Instead of Key

To the Editor:

The item on "radio-controlled door locks" by R. Danbrowney in the Feb. 24 "Why Don't They R & D" is most interesting. However, I don't understand how the idea, as described, could prevent any intruder from turning the dial of the unlocking transmitter until the proper frequency was found, thereby unlocking the door with less effort than with a conventional key-locking door. I suggest the following arrangement:

Use a metal or plastic card with punched holes. Upon inserting the proper card in the door a pickup device would operate the electrical unlocking circuit. If a burglar tried to insert the wrong card, the misplaced holes could easily be arranged to actuate alarm-ringing photocells or contact fingers. All the doors in the house, as well as the automobile, garage, etc., could have the same photocell arrangement so that only one key-card need be carried, and all doors could be locked from one position if desired by providing the necessary relay circuit.

I don't suppose this is an original idea. The major practical difficulty may be electrical reliability; i.e., what happens if power fails, any of the electrical components short circuits, etc. This may be an application for solar batteries. —Harold Belofsky
Bronx, New York

• *Punched cards don't seem like a big improvement over regular door keys. Suppose the transmitted signal was a mixture of two or three frequencies? Each lock would have a tuned pickup to reject everything but its own special combination.—Ed.*

Lost Art

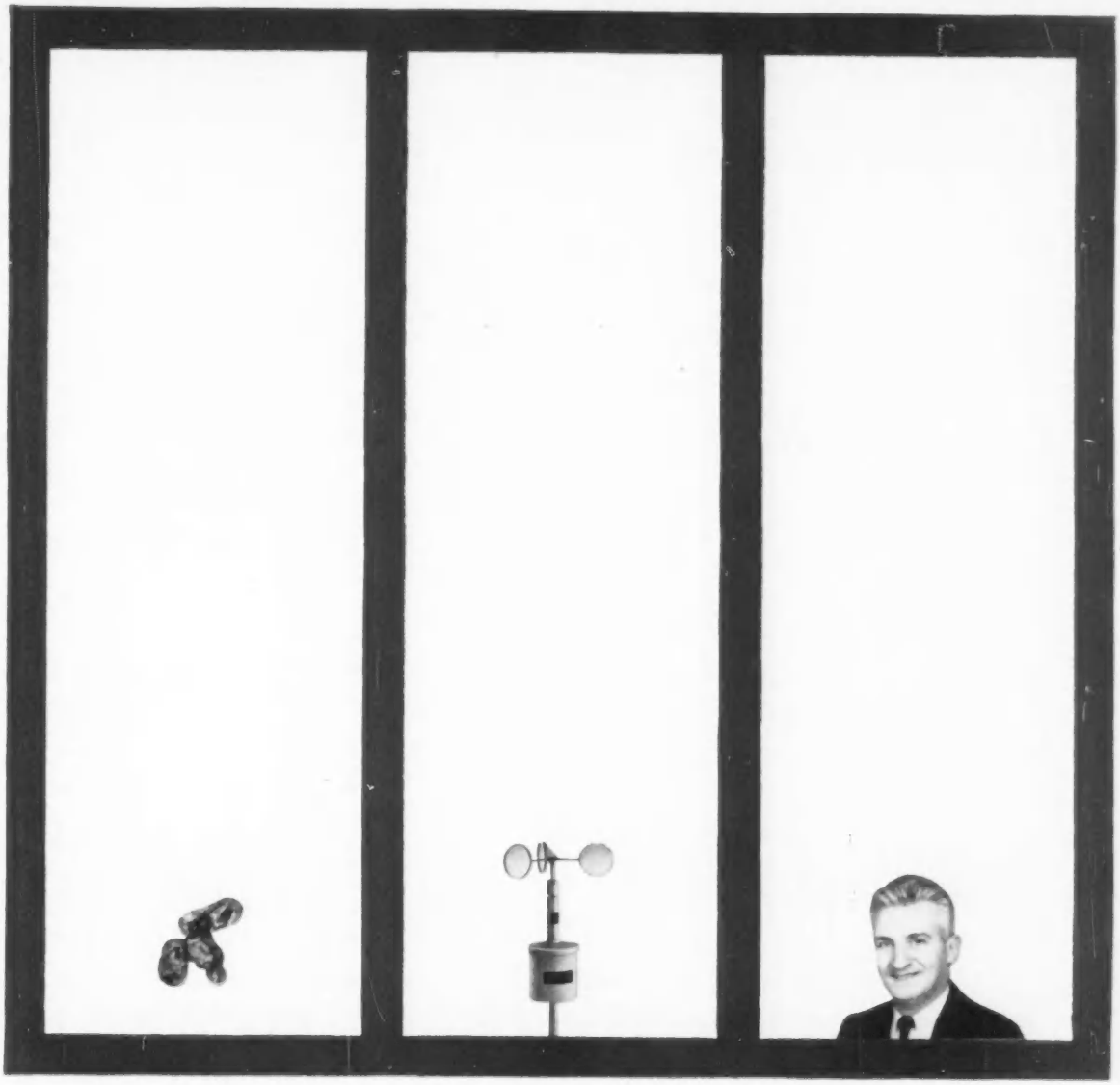
To the Editor:

This is in reference to your article, "Individual Invention—a Lost Art?", by Dr. William J. Kroll (Feb. 24, p. 32). I agree, it is becoming a lost art. Life is much more complex now than at the time of Edison. In a modern, fully equipped laboratory simple things like the electric lamp or a radio could be developed in weeks rather than the years it took in the past. Edison was not alone in trying to develop the electric lamp, but he was the first to be successful. Consider the speed with which advanced electronic computers are developed today. Most new inventions now are quite complex affairs and are much more likely to be the product of a laboratory rather than of a lone inventor.

Another handicap to the lone inventor is the high cost of obtaining a patent. The application fees are very small, but it costs at least $500 in patent attorney fees to obtain a patent.

—James V. Brady
St. Paul, Minn.

WATCH for the special 2-part Design Show Edition of PRODUCT ENGINEERING including a 28-page special report, "The Engineer Comes Into His Own," and a separate 16-page section on the Design Conference and Show Program—also a Loop-area map and eating guide for Chicago.



Miracle Plant! Zoospores of some fungus cover their own length as fast as a Sabrejet. The bacterium *Pseudomonas aeruginosa* (shown many times its size) has been clocked at 31.7 lengths per second. To do as well, proportionate to size, a man would have to run 125 miles an hour.

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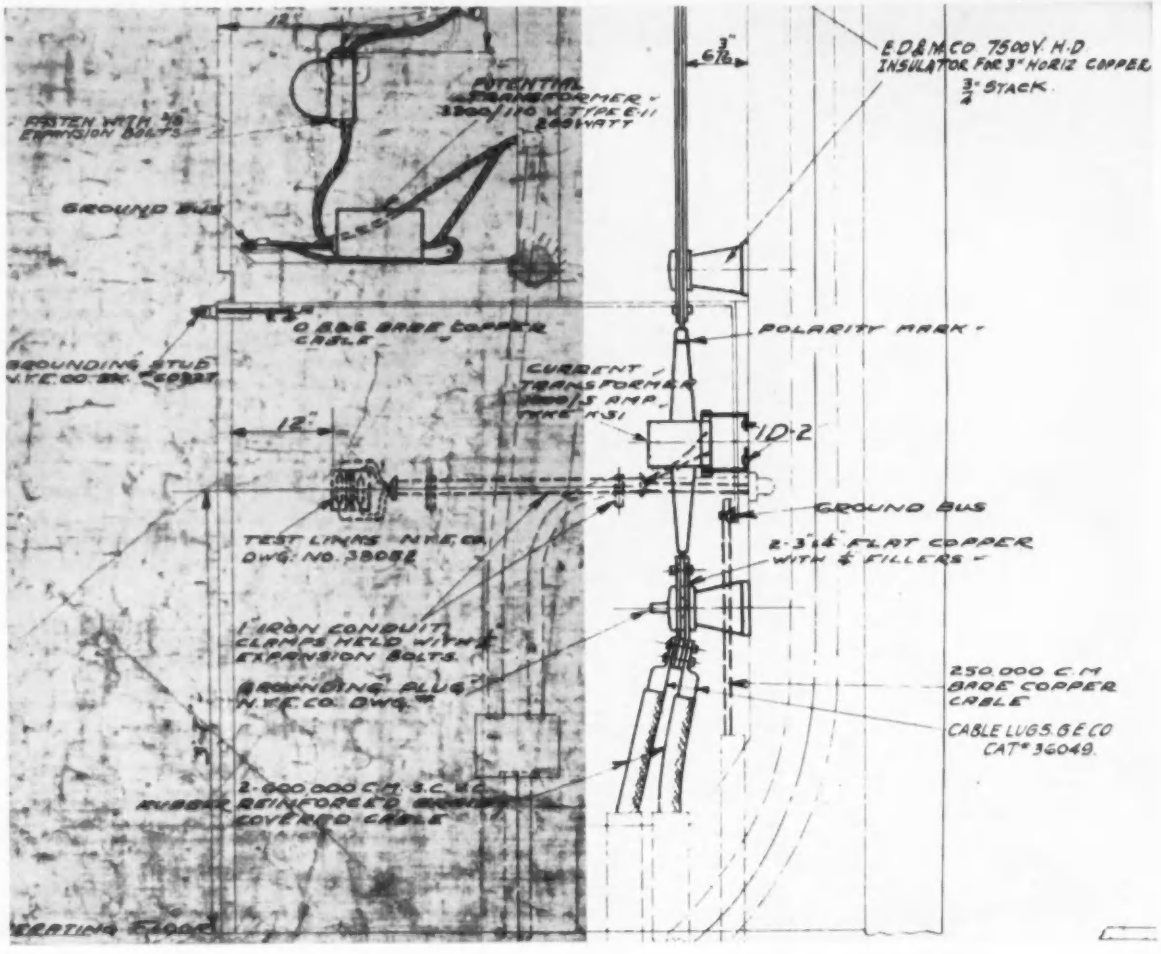
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DEVELOPMENTS TO WATCH...

Rubbers that can take 600 F . . .

. . . for several hours and operate effectively for long periods at 300 F, will be available commercially from a new DuPont plant scheduled to go onstream at the end of this month. These are *Viton* fluorocarbon rubbers, copolymers of vinylidene fluoride and hexafluoropropylene. They'll be expensive, and are not for general use. But DuPont expected them to find plenty of applications in jet engines, high temperature equipment and the like.

In "crude" form, the new rubbers are white and translucent. They can be processed on standard rubber equipment to make O-rings, packings, seals, diaphragms, hose, wire jackets, and the like. DuPont also expects them to serve as a base for heat-resistant and chemical-resistant rubber cements and coatings, and notes that they not only stand oxygen and ozone, but also aliphatic, aromatic, and chlorinated hydrocarbons, dilute and concentrated mineral acids and alkalis. Tensile strength at room temperature is 2000 to 3000 psi; at 300 F, 1000 psi. Resilience at room temperature is 40 to 50%; at 300F, 70%. Elongation is 150 to 300% and 100% respectively.

Rare earths, synthetic sea water, talc . . .

. . . and magnesium oxide are among the materials that can help reduce corrosion in gas-turbine engines (type 310 stainless steel at 1450 F) and make it possible to use residual fuel oil with a vanadium content as high as 200 gpm, say Gulf researchers R. C. Amero, A. G. Rocchine, and C. E. Trautman. They say additives like these not only reduce certain types of corrosion, but also enhance the action of other additives. Most effective combinations: Rare earth and sodium napthenates (mol ratios 0.5RE:1Na:1Vanadium); Manganese napthenate and potasssium carbonate (3Mn:3K:1V); and Manganese naphthenate, sodium napthenate, and synthetic sea water (3Mn:1.4Na:1V).

Another interesting finding: the materials may be dissolved in the oil or added in the form of insoluble powders. Oil-soluble compounds, which are generally more expensive, are not necessarily more effective, the researchers note. (Additive costs for the materials mentioned above would range from less than 1¢ to about 11¢.) A report on the investigation covering about 125 small-scale burner tests was delivered at the Third Annual ASME Gas Turbine Conference in Washington earlier this month.

Masers go to work . . .

. . . in this new signal-generator, on display at the IRE Show. It uses an ammonia maser, basically similar to the ammonia "atomic clock," and takes advantage of the fact that ammonia molecules, as they change from a higher to a lower energy state, oscillate at a frequency that varies less than one part in a billion. For this reason, the unit pictured here is able to generate a 23.8701294 kmcps signal with an accuracy of plus or minus 0.0000005 kmc. (For more information on masers, and their applications for microwave amplification (the name *maser* comes from the initial letters of "Microwave Amplification by Stimulated Emission of Radiation"), see *PE—Jan. 13, '58, p. 10.*)

K-Band Signal Generator consists of ammonia reservoir (top), getter-ion tube, high-voltage supply, and oscillation cavity. Polytechnic Research & Development Co., Brooklyn, N. Y., makes this portable unit that weighs only 20 lb., has an experimental price of $7,000.

American...

(continued)

DEVELOPMENTS TO WATCH...

Valves, welded instead of cast . . .

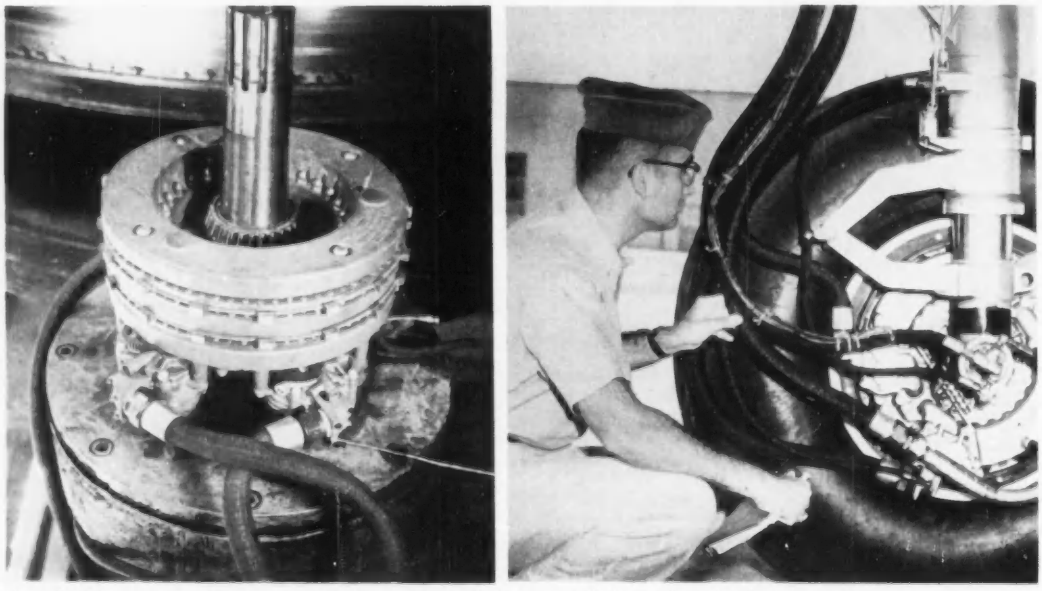
. . . so strength can be built in exactly where it's needed, are being developed by Walworth Co., 60 E. 42nd St., New York 17. With this type of design, it would not be necessary to add weight to a whole unit to strengthen one section. The company isn't writing cast valves off, though. It's designing new ductile-iron components that can capitalize on the special advantages of this material and is modifying standard valves, fittings, and regulators for missile and nuclear use. Says President F. W. Belz of Walworth, "both bronze and carbon-steel valves and fittings are being redesigned for use on missile ground-support equipment, handling oxygen, nitrogen, and helium, and both gaseous and liquid propellants."

Polyethylene parts weighing nearly 2 tons . . .

. . . have been produced at Allied Resinous Products, Inc., Conneaut, Ohio, and the company expects soon to cast a 5000-lb unit with wall thicknesses of 11 to 15 in. The company cannot disclose the end-use of these particular parts; but, because they are boron-filled castings, they are probably destined for atomic-energy use. The important thing, though, is that polyethylene technology has progressed to a point where parts this size can be made. It should open a good many design applications.

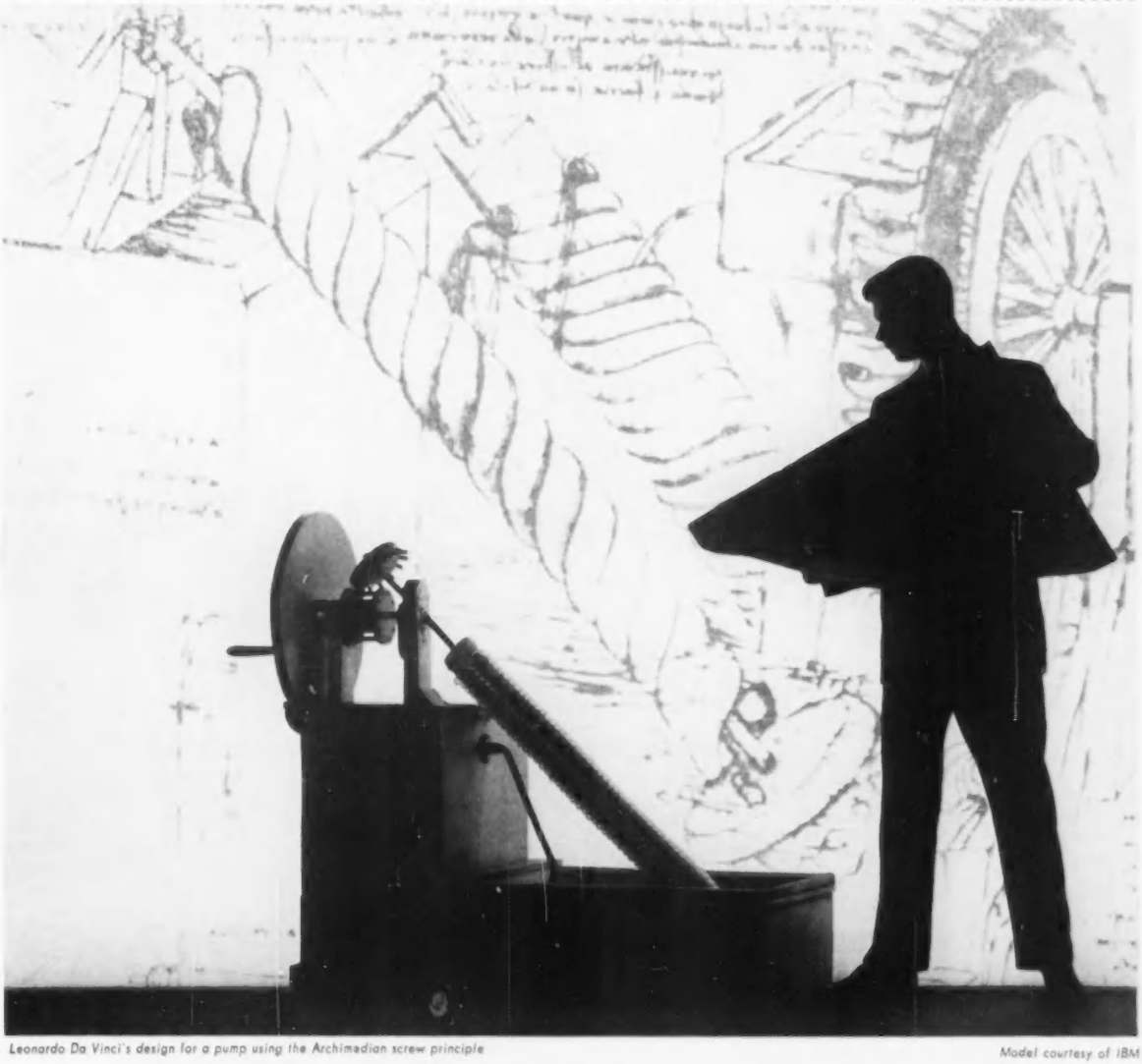
First pictures of liquid brake . . .

. . . developed by B. F. Goodrich for the Air Force (*PE—Mar.* 10, '58, *p.* 8) show how it's built, how it's connected up for testing. Even at landing speeds as high as 160 mph, Goodrich says, the liquid-cooled, disc-type brakes stay at temperatures "well below 500 F," compared with 1500 to 2000 F for conventional braking systems. In addition to the obvious advantage of prolonging brake lining and tire life, the low operating temperature permits use of high-heat-treat axles, and is expected to permit considerable savings in weight as design experience is gained. —ARG



New braking system is shown on dynamometer stand (left), installed on plane for testing, (right).

creative designing calls for an open mind



Leonardo Da Vinci's design for a pump using the Archimedian screw principle

Model courtesy of IBM

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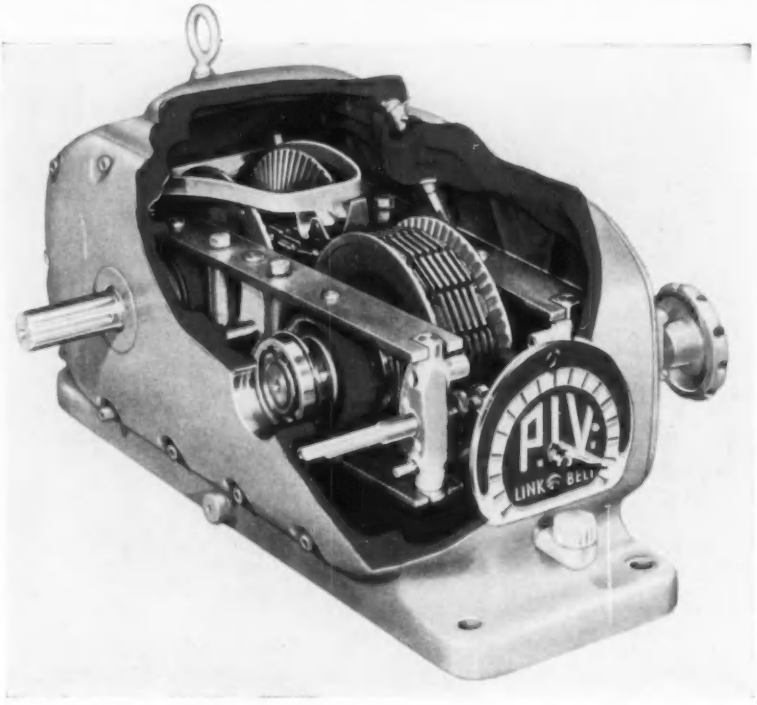

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

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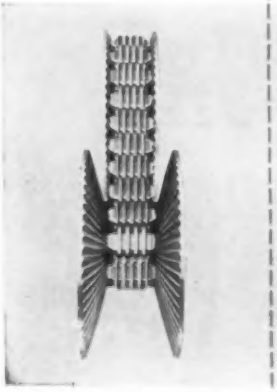
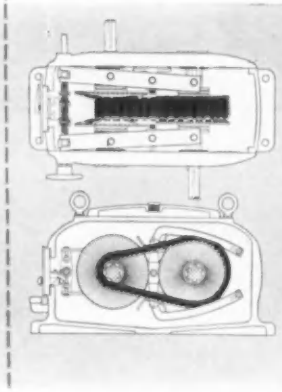
LONG-LIFE ACCURACY and application flexibility of Link-Belt P.I.V. are unmatched by any other variable speed drive. It's available in 8 sizes and 16 standard types, in capacities from ½ to 25 hp—for horizontal or vertical mounting. Compact design simplifies installation as a separate unit or a built-in part of a machine. Even greater application flexibility can be gained by making motor and helical gear sets integral parts of the P.I.V. Of all-metal construction, P.I.V. is totally enclosed, automatically lubricated.

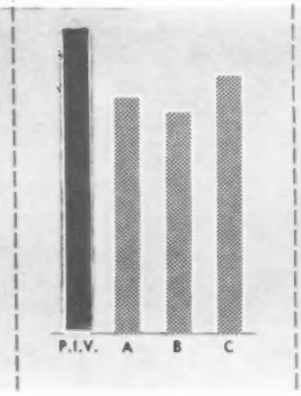
How LINK-BELT P.I.V. differs from other variable speed drives



POSITIVE MESH of self tooth-forming chain with grooved wheels assures full-rated hp at output shaft. All-metal construction . . .



PREVENTS SLIPPAGE because the P.I.V. drive chain does not depend on friction and is unaffected by atmospheric conditions.



UNMATCHED ACCURACY is demonstrated by this actual comparison of maintained rpm of P.I.V. and three other variable speed drives.

GREATER COMPACTNESS results from short-center arrangement of drive mechanism. Some P.I.V. models save 50% on floor space.

American ...Washington

DEVELOPMENTS TO WATCH...

Another boost in defense spending . . .

. . . is in the works. The Defense Dept. is putting together a supplemental appropriation request of at least $1.5 billion for fiscal 1959, starting July 1. This will be tacked on to the $39.1 billion budget sent to Congress in January, now under study by the House Appropriations Committee. Reports are that there will be still another supplemental money request for the 1958-59 period to be drafted this fall.

Odds are the latest request will include funds for these projects:

- Development and launching of space vehicles and satellites. Proposals are now pending before the newly-organized Advanced Research Projects Agency.
- Continued production of Boeing's B-52 heavy and KC-135 jet tanker, now scheduled to halt by the end of 1959.
- Construction of at least three more atomic-powered, Polaris IRBM-armed submarines.
- The Bell Telephone Labs-Douglas Aircraft Nike-Zeus anti-missile missile.
- The Air Force's new "Minuteman" solid-propellant ICBM which will be launched from underground sites. The Air Force seeks a weapon system contractor to direct development of the project. Several firms—among them, Aerojet-General, Thiokol Chemical, Grand Central Rocket, and Phillips Petroleum—are competing for the propulsion system subcontract. Guidance subcontracts are likely to go for advanced versions of the GE-Burroughs or Arma-Bell Labs-Sperry Rand systems developed for the Atlas and Titan liquid-propellant Intercontinental Ballistic missiles.
- The Air Force's Martin Titan ICBM—with special stress on research for liquid propellants more easily handled and stored than the liquid oxygen oxidizer used in long-range rockets.

New federal subsidies for aid to education . . .

. . . are in trouble in Congress. The administration's highly-touted, multi-faceted program may be okayed in part, but odds are strongly against congressional approval of the whole package. There's enthusiasm for federal scholorship-fellowship help for needy students, and expansion of the National Science Foundation's summer institute of "brush-up" courses for high school science teachers.

But many professional educators are dubious about the administration's proposals, and prefer the Democrats' plan for more generous scholarship aid—plus flat grants to teachers who take career counselor training or attend summer institutes. Eisenhower's broader program aims at much the same goal, but is criticized as inadequate and too administratively cumbersome.

Anti-recession drive to put military orders . . .

. . . in labor surplus areas will not have much impact on the pattern of development and production of defense hardware. Fact is there's been a policy for years, granting special preference to smaller companies in regions hard hit by unemployment. It's questionable whether this policy can be effectively expanded now, except maybe for new military orders for such items as clothing and for some simple, standardized small parts for weapons and other equipment.

Top researchers and economists will meet here . . .

. . . May 20th to show what the impact of research and development spending has on the nation's economy. At the meeting, prime emphasis will be laid to the role of research and development spending and how it works toward the stabilization and the promotion of economic growth in this country's periods of recession.

Sponsored by the National Science Foundation, speakers include Raymond J. Saulnier, Chief Economic Advisor to the President; Guy Smith, Vice President and Director of Research for General Electric; Ralph E. Burgess, Director of Economic Research, American Cyanamid Co; Bertrand Fox, Director of Research, Harvard Business School; and Ralph J. Watkins, Director of Economic Studies, The Brookings Institution.

World-wide ...

DEVELOPMENTS TO WATCH...

Nickel-free stainless steels . . .

. . . claimed to represent an advance over US alloys of this type (*PE—Dec. '56, p. 151*) point up India's metallurgical progress. Proudly unveiling new facilities at the National Metallurgical Laboratory, Indian metallurgists announced a new chrome-manganese-nitrogen alloy that they feel is "as good as chromium-nickel steel." Whether or not their claims for this particular alloy are justified, their combination of interest, abundant raw materials, and up-to-date research facilities, make them well worth watching.

Rayon from bamboo . . .

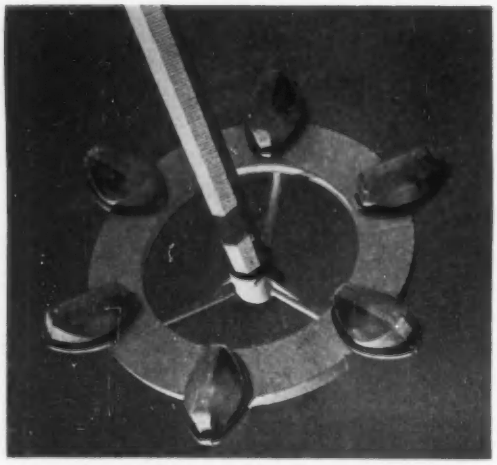
. . . may open new vistas for the Asian economy—and new opportunities in equipment design. Such a process has long been sought, never quite found. But Prof. Masao Horio, dean of the Kyoto U. engineering department, working on assignment from the Indian government, believes he has a practical process at last. The Indian government apparently thinks enough of it to sponsor design of a production plant. Now, the Japanese hope to interest the Pakistan Industrial Development Corp. in a similar enterprise.

To cut dielectric losses . . .

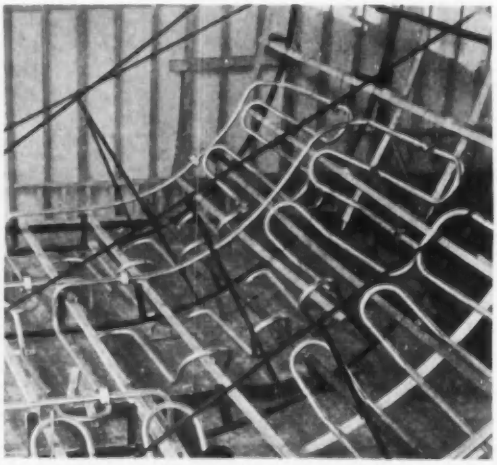
. . . use wool wax instead of petroleum impregnants in paper capacitors say researchers at the Div. of Electrotechnology, Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia. Furthermore, they say, use of wool wax increases capacitance 10 to 20% and improves breakdown strength. Australians are encouraging tests by several companies in this country.

Aluminum tackles big new jobs . . .

. . . all over Europe. Norwegian boat-builders, for instance, are now substituting all-aluminum and aluminum-brass tubing for the standard copper heat exchangers (see photograph, below right). Siemens-Schuckert, AG, Erlangen, Germany has a new design for a mercury road light in which an aluminum-silicon alloy serves as both container and reflector for the mercury lamps, and an aluminum ring is the primary lamp-holder (photograph, below left). The Norwegian heat-exchange tubing, made by A/S Skarpenord, Langesund, is to be sold throughout Europe; the lamps are being road-tested.



German road light takes six high-pressure mercury bulbs —1000; 3000; or 5000 watt, uses aluminum reflector.

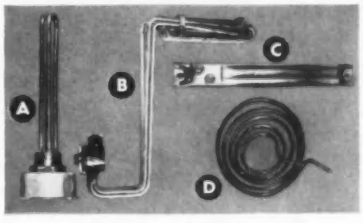


Heat-exchange tubing made of aluminum by Norwegian company is being installed in new 38,000-ton tankers.

How to choose electric heaters for liquid heating applications

Here is condensed information to help you get the most economical electric heaters for your liquid heating design problem.

Three factors generally determine which type heater should be used for any particular liquid-heating application. They are: the physical characteristics of the container, the nature of the liquid, and the temperature requirements.



General Electric "screw-in" immersion heaters (a) have threaded headers, which make for easy and permanent installation in pipes, tanks and vessels. "Over-the-side" immersion heaters (b) hang in tanks or containers, and besides being portable, they are ideally suited for heating rubber-lined tanks, lead-lined tanks, tanks of wood, slate, and other materials which are not adaptable to heaters with threaded headers.

Because some metals are subject to attack when immersed in certain liquids, G-E heaters are made in a variety of sheath materials so that they can be used for a wide range of liquids. Sheath materials of copper, steel, stainless steel, nickel, nickel-plated copper, nickel-silver, Inconel, Monel, cast iron and lead are all available.

General Electric heaters are ideally suited to heating a wide range of liquids: Water, oil, electroplating baths, cleaning compounds, chemical baths, and other fluids. These liquids can be circulating or non-circulating; in open containers, closed or pressure, vessels, kettles, or steam generators. Heavy viscous liquids, such as pitch, molasses, and asphalt can be heated by using a liquid jacket containing immersion heaters.

Where extremely corrosive liquids are to be heated, it is also often best to use a water jacket around the tank. Immersion heaters may be used for water heating in this type of application. Many times, it is easier to clamp strip heaters (c) or tubular heaters (d) to the side of the tank.

TABLE I—Water, Alkaline or Plating Baths

Amount of Liquid		Degrees F Temperature Rise						
Cubic Feet	Gallons	20	40	60	80	100	120	140
		Kilowatts to Heat in One Hour						
.66	5	0.3	0.5	0.8	1.2	1.6	2	2.7
1.3	10	0.5	1.1	1.6	2.4	3.2	4	5.3
2.0	13	0.8	1.6	2.4	3.6	4.5	5.7	7.2
2.7	20	1.1	2.2	3.2	4.8	6	7.5	9.5
3.3	25	1.3	2.7	4	6	7.5	9.5	12
4.0	30	1.6	3.2	4.8	7	8.8	11	14
4.7	35	1.9	3.7	5.6	8	10	13	16
5.3	40	2	4	6	9	12	15	20
6.0	45	2.4	5	7	11	14	18	23
6.7	50	2.7	5.4	8	12	15	19	24
7.4	55	3	6	9	13	16	20	25
8.0	60	3.3	6.4	9.6	14.5	18	23	29
8.7	65	3.5	7	10	15.5	19.5	25	31
9.4	70	3.7	7.5	11	17	21	26	33
10	75	4	8	12	18	23	29	37
10.7	80	4.3	8.5	13	19	24	30	38
11.4	85	4.5	9	13.5	20	25	31	39
12.0	90	5	10	14.5	22	28	35	44
12.7	95	5	10	15	23	29	37	47
13.4	100	5.5	11	16	24	30	38	48
16.7	125	7	13	20	30	38	48	60
20.0	150	8	16	24	36	45	57	72
23.4	175	9	18	28	42	53	67	85
26.7	200	11	21	32	48	60	75	95
33.7	250	13	27	40	60	75	95	120
40	300	16	32	47	70	88	110	140
46.8	350	19	37	56	83	105	130	165
53.4	400	21	43	64	96	120	150	190
60.1	450	24	48	72	107	135	170	214
66.8	500	27	53	80	120	150	190	240
Maximum Time (hours)		10	10	7	5½	5	4	3½

TABLE II—Use This Table For Oil

Amount of Oil To Be Heated		Degrees F Temperature Rise					
Cubic Feet	Gallons	50	100	200	300	400	500
		Kilowatts to Heat in One Hour					
.5	3.7	.3	.5	1	2	2	3
1	7.4	.5	1	2	3	4	6
2	14.9	1	2	4	6	8	11
3	22.2	2	3	6	9	12	16
4	29.9	2	4	8	12	16	22
5	37.4	2	4	9	15	20	26
10	74.8	5	9	18	29	40	52
15	112.5	7	14	28	44	60	77
20	149.6	9	18	37	58	80	102
25	187.	11	22	46	72	100	127
30	222.5	13	27	56	86	120	151
35	262.	16	31	65	100	139	176
40	299.	18	36	74	115	158	201
45	336.5	20	40	84	129	178	226
50	374.	22	45	93	144	197	252
55	412.	25	49	102	158	217	276
60	449.	27	54	112	172	236	302
65	486.	29	58	121	186	255	326
70	524.	32	62	130	200	275	350
75	562.	34	67	140	215	294	375
Maximum Time (hours)		10	10	8	7	6	5

To figure the amount of heat required for your application:

1. Find the number of gallons or cubic feet of liquid to be heated.

2. Figure needed temperature rise in degrees F. (Subtract initial temperature from needed temperature.)

3. Check either Table I or Table II from the nearest amount of liquid to the desired "temperature rise" in the right-hand column.

4. Add 4% to the figure you now have if there is no insulation on your container or tank.

5. Divide the answer in Step 4 by the number of hours available for initial heat up of the liquid. You now know how many kilowatts of heat are required for your installation.

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GENERAL ELECTRIC

What's happening in SCIENCE

Planning for trips to the moon

Four types of lunar flights are now under consideration, Robert W. Buchheim told U. of California's space technology seminar:

1. One-way flight, planned for direct impact, with the vehicle striking the lunar surface at full approach velocity.

2. Circumlunar flights—roundtrips without a landing on the moon.

3. Landings on the moon, with the velocity reduced to "a level compatible with the survival tolerance of the payload."

4. Establishment of an artificial satellite of the moon.

For any or all of these flights, says Buchheim, projection velocity would have to be about 35,000 ft/sec by the time the vehicle reached a level a few hundred miles above the earth; but getting to the moon is not just a problem of attaining a high speed. It will have to be a precisely controlled speed. Buchheim estimates that tolerances on take-off speed must be on the order of 10 ft/sec for flights aimed directly at the moon, and 0.1 ft/sec for circumlunar flights with return to a preselected recovery area.

As Krafft Ehricke points out, an error tolerance this small practically rules out "ballistic" (unguided) travel to the moon or to the nearby planets. An error of 1 ft/sec at hyperbolic cut-off, 300 naut mi above the earth, would mean an error of more than 20,000 mi. when the rocket reached the vicinity of Mars or Venus.

briefs . . .

Earth is slowing down. British scientists report. Measurements with a cesium "atomic clock" (see *PE—Nov. 4, '57, p 12*) at the National Physical Laboratory indicate that the length of day has increased one-thousandth of a second in the past two years. As the British proudly note, this change is "at least one hundred times as great as the error in the clock."

Infrared cameras that can take daytime pictures of satellites are "progressing nicely," Eastman Kodak reports. One has been set up and 11 more are on the way. Kodak engineers are developing special film for use in the cameras —a fast, 55.625-mm, high-contrast medium on an aerographic base.

For a better look inside

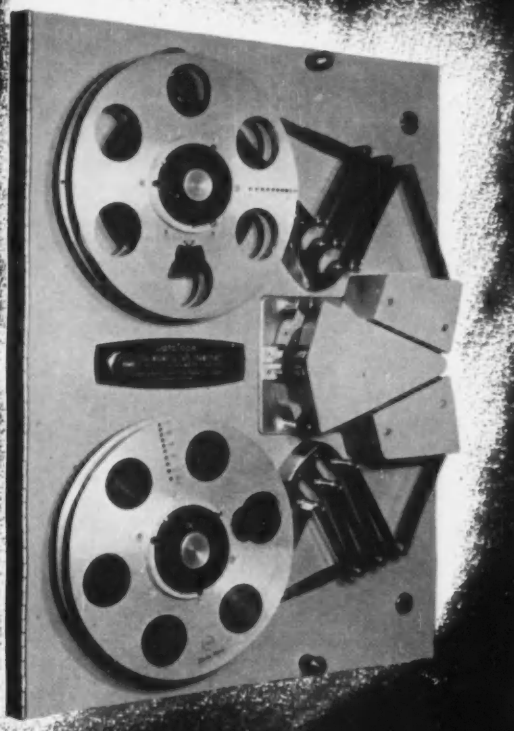
A new kind of microscope, an X-ray microfluoroscope, (photographs below) that permits visual observation at 2000 power "with an accuracy and depth of focus that an ordinary microscope can't match," has been developed by Dr. Howard H. Pattee, Jr., of Stanford U. He says it will permit quantitative X-ray absorption measurements of mass, thickness, and content of structures down to cubic micron size, and believes it should be useful for motion as well as still photographs.

In operation, it is much like an ordinary fluoroscope, collecting electron beam radiation that has passed through the object being viewed on a fluorescent screen. But special phosphors are used for the screen (metal silicate powders evaporated on a quartz plate), and a special X-ray beam is used. (The beam is 10 microns in dia, has a voltage of 10 kv, and a current of 100 microamps.)

Next step—and a fascinating possibility—is a grainless screen. Says Pattee, "Completely grainless screens are possible with certain organic dyes." He's working on them now. Also being developed—a television-type X-ray scanning microscope. —ARG

New microfluoroscope creates picture of object on fine-grained fluorescent screen.

Mica splinter, viewed under microfluoroscope, has shadowy appearance characteristic of X-ray pictures. (At right, for comparison, is conventional microscope view.)



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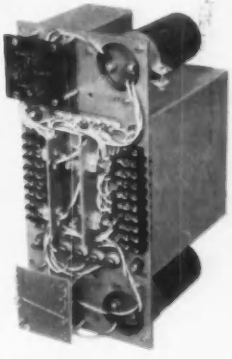
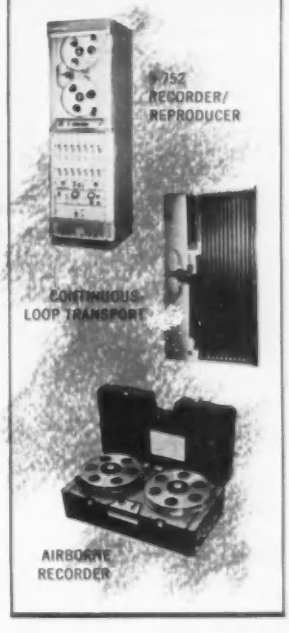


**Modularized components, such as Power Supply Unit at right, permit instant access and easy maintenance or replacement with minimum down-time.*



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OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

What's happening in MATERIALS

Plastics from the feed bin?

It's beginning to look that way. Sugar-based resins are already in the pilot-plant stage (*PE—Feb. 27, '58, p. 7*). Now, it looks as though amylose-starch resins can provide new coatings, films, and fibers. Says Paul Kaplan of Stein, Hall & Co: "Amylose is chemically similar to cellulose and has excellent film-forming properties and high strength." Films and coatings can be made soluble or insoluble in water, and are highly resistant to greases. Too, they're potentially lower in cost than other film-formers of comparable strength.

Much research is now being done on amylose and its derivatives—in Europe as well as in the US, on the farm as well as in the lab. As I. A. Wolff of the Dept. of Agriculture's Northern Utilization R&D Div. points out: High-amylose starches seem most desirable for resin development. A corn starch with 80 to 90% of amylose should have good elasticity and strength, be insoluble in alcohol and water, and possess marked film-forming characteristics. Present-day starches are only about 25% amylose, but DofA scientists believe genetic research can bridge the gap.

Hybrid corn yielding 50 to 80% of amylose has already been developed, and "prospects are good for a steady increase."

When such starches are available, they should not only prove useful in resins and coatings fibers, but also for new synthetic fibers and for paper that offers greater durability and water-resistance.

This foam won't stick

A plastic foam that can be poured and expanded right around instruments and delicate parts, yet won't adhere to bare glass or metal, has been developed at Wright Air Development Center. It was originally aimed at packaging applications (to eliminate need for paper or plastic wrapping to protect the product from the foam). Now, though, it seems to have several advantages: higher compressive strength, increased resiliance, and better moldability.

According to WADC "non-stick" properties can be imparted to either polyester or polyether isocyanate foams simply by adding a fatty acid—stearic, for instance—to the foaming mixture. (For more information on foamed plastics, both polyester and polyether types, and for news of another "natural" material that alters foam properties, see *PE—Sept. 23, '57, p. 5 and Oct. 21, '57, p. 6.*)

briefs . . .

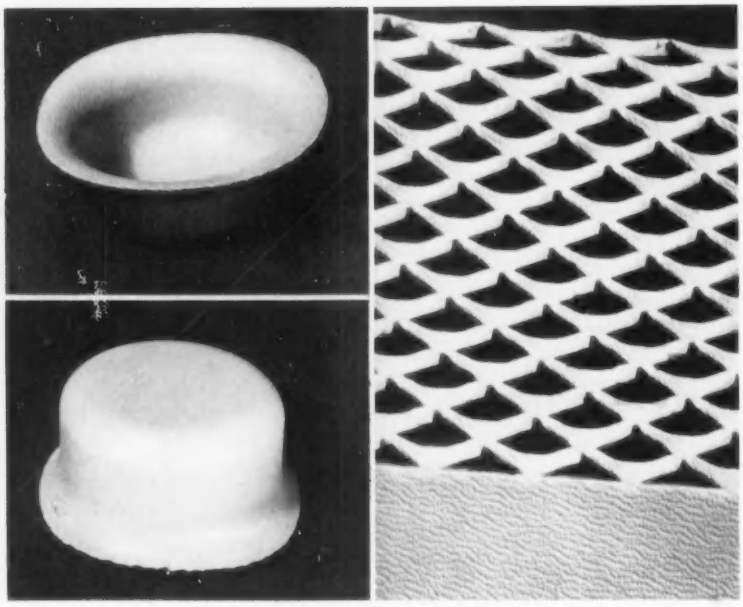
Aluminum has made it at last. The Aluminum Association is now quoting production figures in tons instead of pounds, apparently confident that the annual level will stay above the million-and-a-half ton mark. Now perhaps the plastics industry, still boasting of "billion-pound" outputs, will take the giant step, too.

New process for gallium might increase availability of this rare and tantalizing metal, help bring its price down from the current $1350 a lb. Patented by two Dow Chemical engineers, the process involves treating the ore with hydrogen chloride or hydrogen bromide at a temperature of 1300 to 1700 F. (One of gallium's unusual properties is its wide liquidus range. It melts at 85 F, boils at 3600 plus—see *PE—Mar. 17, '58, p. 66*).

—ARG

Clad steel in Britain

Vinyl-clad sheeting is scoring gains in Britain as it is in this country. As the photographs here show, adhesion of coating to base metal is now good enough so that material can be subjected to rather severe forming operations without delamination. This sheeting, known as Stelvetite, is produced by John Summers and Sons, Ltd., Shotton, Chester. It has a 0.014 in. polyvinyl-chloride (PVC) coating on a steel base, comes in lengths to 12 ft; widths to 4 ft. (For other news of plastic-coated steel, see *PE—Mar. 17, '58, p. 73*).



Plastic coating adheres well to steel even when the metal is deep-drawn or expanded. Note how it conforms to sheared edges in photograph at far right. Note, too, variety of textures.

Cutaway section of Douglas Aircraft acoustic window used on the DC-7 below. The noise barrier is an acrylic pane (A) mounted in a foam rubber damper (B). Damper is retained in a metal pan (C). A flexible HYPALON seal (D) is compressed between the inner pane and the double thickness outer window (E). A neoprene seal (F) is cemented to the metal retainer.

Douglas Aircraft seals new acoustic window with Du Pont neoprene and HYPALON®

Douglas Aircraft has developed an improved acoustic window, designed for pressurized aircraft cabins. It is now in use on the DC-7, and a similar design will be used on the new jet DC-8. To meet the rigid demands of flight conditions, two Du Pont elastomers – neoprene and HYPALON – were selected to seal the window.

The flexible seal between the noise barrier and double pane (see D in diagram) required a resilient material with complete resistance to ozone and high color stability. In addition, the material had to show good low temperature flexibility without the addition of a plasticizer. (Plasticizers become volatile at the low pressures found at high altitudes, and condense on the window panes.)

Douglas engineers chose HYPALON because it was the only elastomer to meet these specifications. HYPALON has complete resistance to ozone. Unlike most rubbers, it can be compounded in a wide range of stable colors without sacrificing its other properties. This versatile synthetic rubber resists hardening at extreme temperatures (250° F.-350° F.) and retains its flexibility at temperatures as low as –40° F. without the use of a plasticizer.

Neoprene was chosen for the inner seal (F in diagram) because of its high resistance to ozone cracking. It retains its resilient properties in the face of heat, flexing, weather and sunlight. Neoprene is resistant to oil, chemicals, abrasion and cutting . . . and will not support combustion.

Investigate the design possibilities of Du Pont neoprene and HYPALON. Neoprene is currently used in aircraft fuel line connectors, heating system hose and cable jacketing. HYPALON is used in molded and extruded parts, fabric coating and convertible tops. For more information on the uses and properties of these versatile Du Pont synthetic rubbers, just clip the coupon below and mail today.

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DESIGNING WITH ALUMINUM

NO. 27

This is one of a series of information sheets that discuss the properties of aluminum and its alloys with relation to design. Extra or missing copies of the series supplied on request. Address: Advertising Dept., Kaiser Aluminum & Chemical Sales, Inc., Department PD-1, 919 N. Michigan Ave., Chicago 11, Ill.

THE USE OF ADHESIVES IN FABRICATING ALUMINUM PRODUCTS

LOW COST, VERSATILITY, EASY APPLICATION AND GOOD PHYSICAL AND CHEMICAL PROPERTIES ARE AMONG THE ADVANTAGES OF USING ADHESIVE BONDINGS IN FABRICATING ALUMINUM PRODUCTS.

ALTHOUGH most proprietary adhesives are compounded for specific bonding jobs where certain properties are necessary, they are generally composed of the types listed in Table I. As the table shows, there are many methods of bonding, plus a variety of curing schedules. This versatility of adhesive bonding techniques and joints is the reason for their rapidly expanding use with aluminum. The simplicity of adhesive bonding has also contributed to this success. And the low cost of adhesives has helped them to gain access to jobs formerly held only by solders.

Design Considerations

Design possibilities with adhesively bonded aluminum structures are limited only by extremes of stress, temperature and corrosive environment. Through the use of adhesives, aluminum can be joined to many different materials in one operation.

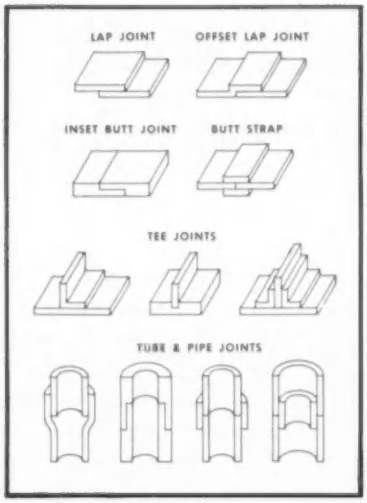
There is only one special consideration in designing for the use of adhesives in joining aluminum; peeling stresses should be kept as low as possible. In some cases it may not be possible to avoid them, but proper joint design will reduce them greatly, thereby assuring a long service life. Figure 1 shows how joints may be designed to minimize peeling stresses which might otherwise exceed the strengths of the adhesives or the materials being joined.

Pretreatments

The pretreatments used in adhesive bonding of aluminum are concerned only with cleaning the surface. In most cases, it is not even necessary to remove the metal's natural protective oxide coating. The cleaning treatment should be selected with joint strength requirements in mind.

For lower strength joints, the ordinary mill finish of aluminum is clean enough. Solvent degreasing to remove thin films of production and handling oils is necessary for intermediate strength joints. Where the adhesive bond must develop the greatest strength possible, a chromic-sulfuric acid dip is usually recommended as the best chemical cleaning method. When a variety of materials are to be bonded together, it may be necessary to use several different cleaning methods on the joint areas before bonding.

FIG. 1



Methods of Applying

The adhesives themselves may be applied by any of several techniques depending upon the nature of the adhesives and the desired properties of the joint. Roller coating is particularly effective for high speed application of a thin coat of adhesive, as in the production of laminates. Various building materials are currently being adhesively laminated with aluminum foil to increase their thermal insulation properties.

For more limited areas, the adhesives may be applied by brush, blade or spray, which are the more familiar methods. However, certain adhesives are being adapted to mass production practice by their manufacturers who are turning them out in film form. This film is then cut into sheets, ribbons or special shapes which follow the contours of specific joint areas. These precut shapes are then assembled with the metal parts before curing.

Curing

Curing processes for adhesives used in bonding aluminum vary considerably with their type and form. The length of curing time may range from three seconds to 76 hours or more depending upon the type of adhesive and whether or not heat and pressure are applied to the assembled joint. Table I shows the curing times generally used with different types of adhesives. Either heat or pressure, or both, must be used to obtain the highest bond strengths.

Properties of Adhesive Bonds

Although adhesives have been used extensively in bonding aluminum and other metals in jewelry, electronic components and other relatively noncritical items, they can also be used where strengths in the neighborhood of 8,000 psi are required in tension or shear. Table II shows the strengths attainable with various adhesives when used to bond aluminum to aluminum. In general, adhesives are resistant to water and hydrocarbons, an important factor to the manufacturers of containers.

TABLE I

ADHESIVES COMMONLY USED IN BONDING ALUMINUM*

Type	Usual Bonding Methods	Common Curing Time	Resistance to		Performance in Use		Typical Applications
			Water	Hydrocarbons	Structural	Non-Structural	
Polyvinyl Acetates	Solvent Release Water Evaporation Reactivation	At 250°F–350°F, 3 sec	Poor to Fair	Good to Excellent	Poor	Excellent	Aluminum to aluminum, glass, ceramics, mica, wood, cork, leather, cloths, paper and many plastic films.
Cellulose Nitrates	Solvent Release	At room temp. 90 min–24 hr	Excellent	Excellent		Good	Aluminum to aluminum, glass, wood, leather, cloths, thermoplastic resins, etc.
Natural Rubbers	Solvent Release Pressure Vulcanization Water Evaporation	Room temp. 24 hr, 260°F–350°F, 10–30 min	Excellent	Poor	Poor	Excellent	Aluminum to aluminum, tile, glass, wood and metal attachments.
Synthetic Rubbers	Solvent Release Pressure Vulcanization Water Evaporation	Room temp. 24 hr, 260°F–350°F, 5–30 min	Excellent	Poor to Good	Poor	Excellent	Aluminum to rubbers, fabrics, foils, plastics, etc.
Alkyds	Contact Pressure at room temp.	10 min–24 hr	Excellent	Excellent	Fair	Excellent	Aluminum laminations and as sealer.
Epoxys	Catalyst Heat Contact Pressure	12–76 hr 10 min–24 hr	Excellent	Excellent	Excellent	Excellent	Aluminum to aluminum, glass, ceramics, many plastics, cyclized rubbers and wood.
Phenolics	Heat and Pressure	5–10 min	Excellent	Excellent	Good	Excellent	Aluminum to aluminum, wood and glass. Adhesive modifiers.
Phenolic-vinyl	Heat and Pressure	5–45 min	Excellent	Excellent	Excellent	Excellent	Aluminum to aluminum and wood.
Phenolic-polyvinyl butyral	Heat and Pressure	5–45 min	Excellent	Excellent	Good	Excellent	Aluminum to aluminum, wood, synthetic rubber and plastics.
Phenolic-polyvinyl formal	Heat and Pressure	5–45 min	Excellent	Excellent	Excellent	Excellent	Aluminum to aluminum and wood (aircraft construction).
Phenolic-Neoprene	Heat and Pressure	15–30 min	Excellent	Excellent	Excellent	Excellent	Aluminum to aluminum, wood and many plastics.
Phenolic-Buna-N	Heat and Pressure	15–30 min	Excellent	Excellent	Excellent	Excellent	Aluminum to aluminum, brake linings and electrical assemblies.

*Many proprietary adhesives are formulations consisting of a number of basic resin types compounded to achieve specific properties for a specific application.

Some of them offer great resistance to impact in shear, while others maintain their strengths at temperatures higher than 400°F.

Cost Advantages

Today, adhesives range in price from thirty-five cents to five dollars per pound. The lower priced adhesives are the type most generally used in making laminates, the more expensive types for seam bonding. Because adhesives are applied at eight to nine pounds per 1000 square feet, the most expensive adhesive bond costs only one-third the price of an equivalent soldered joint.

For further information and assistance in design or application of adhesives to aluminum, contact the Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois; *Executive Office*, Kaiser Bldg., Oakland 12, California.

TABLE II

STRENGTH RANGE OF ADHESIVE BONDS

Aluminum to Aluminum

Type	Typical Cure Schedule	Approx. Tensile-Shear Al to Al Bonds, psi	Specific Application
Natural and Synthetic Rubbers	Pre dry 1 hr/150°F 5 min/300°F/300 psi	1,150	Aluminum name plates to appliances.
Polyvinyl Acetates	Solvent Release: 230–250°F 5–10 min 350°F ½–2 sec	1,500	Aluminum sheet and foil to masonite. Aluminum foil to paper.
Phenolic Blends	60 min at 350°F and 150 psi	4,200	Aircraft structures.
Epoxys	2 hr at 150°F 10 min at 300°F	6,000 to 8,000	Honeycomb Sandwich and aircraft structures.

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The EAGLE, the LION, and the BEAR

Once upon a time, an eagle, a lion and a bear lived in a quiet valley near the sea. The valley was their whole world, but it was a large and fruitful land. The eagle soared on the high air currents near the mountains; the bear ranged the slopes for berries and honey; the old lion ruled the great green plains. They rarely met, these three great beasts, and each was king in his own domain.

But a flood came and water covered the plains. The lion found himself king of only watery wastes. The bear, too, almost drowned–but the eagle, with his high nest, was safe. He helped the lion and the bear, led them to dry places and brought them food. All the beasts admired and envied the eagle's strong wings.

When the waters were finally beaten back, the old lion was exhausted. The smaller animals, seeing this, laughed at his bedraggled coat. And the bear, grumpy as always, acted as if he had turned back the waters all by himself. He ate up any small animals who argued with him.

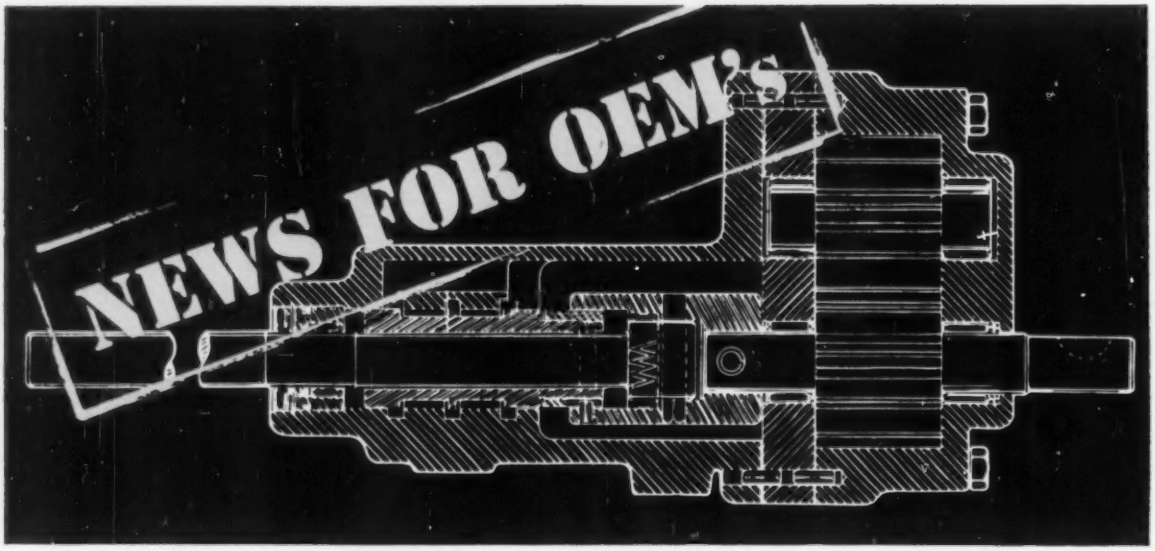
At first the eagle went back to the high peaks–but the old lion couldn't seem to get his strength back, and the many small animals cried out for help. And so once again the eagle ranged the valley, helping where he could, warning of the bear's evil intentions. He brought life-giving presents and food, but threatened to bring no more unless the little animals helped each other against the bear.

The bear soon realized that he needed the little animals. While he had less to give, he gave without exacting promises–to those animals close to his home. They came to his den and he let them play with his cubs to show they were "all animals together." Thus he talked of freedom, but bound the others to him.

Then the bear began to range further afield. He sent his cubs out and won away the ibis, the Syrian lion, and made the elephant doubtful. He claimed he could throw rocks into the eagle's nest from the cliffs above. And when the eagle spoke softly, the other animals thought he was afraid. They forgot the eagle's many presents. They doubted if he could protect them from the bear.

The eagle was disturbed. He could only do what he thought was right, but his troubles multiplied. There were so many to help–and his own eaglets needed attention. Unhappy, uncertain about what to do, he took a long flight across the valley. Up, up he went in the limitless sky, reveling in his freedom–and then he realized that it was *this freedom* he had to give the other animals. Food and gifts were not ends in themselves, but means, tools, saws to cut the chains of toil and unthinking obedience.

He saw that he could not give his friends wings, but he might teach them how to make wings of their own. And he might teach them how to fly–the greatest gift of all, and one that needs to be given only once.



NOW! *Expanded production makes* HYDRAULIC SERVO MECHANISM

available to MORE original equipment manufacturers

Originally known as the Behlen Powr-Steer, this advanced rotary type hydraulic servo mechanism has proved highly successful on thousands of farm tractors of many models and makes. Behlen was first to offer power steering for row crop tractors, five years ago. For the past two years, Powr-Steer has been used on a leading farm tractor line as original equipment. Demand soon outstripped our production capacity.

Now Behlen production facilities have been expanded to the point where we can offer our Hydraulic Servo Mechanism to a wide field of manufacturers of industrial heavy construction and agricultural equipment. From tractors to earth-movers. From fork-lift trucks to power shovels — every type of equipment where manual labor needs to be reduced.

In supplying the hydraulic "muscle" of Behlen's servo mechanism to your product, you will add magic to its sales appeal.

We invite you to see how easily the Behlen Hydraulic Servo Mechanism can be applied to your products as original equipment (or as extra equipment readily installed in the field). Your request (which will not obligate you in any way) will receive the personal attention of our production manager, Howard Christenson.

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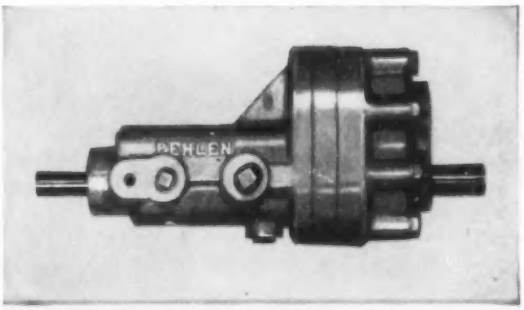


The Behlen Hydraulic Servo Mechanism, Rotary Type, Series 2000, can be used for power steering or wherever a rotary servo motion is required. Controller and actuating parts are in one compact unit, for economy and simple installation.

FULL 360° OPERATION

The Behlen unit is a gear-type hydraulic mechanism (in contrast to the piston type on passenger cars and other equipment). The power source in the unit is a gear motor that will provide continuous 360° turning under full power in either direction.

The power unit is mounted anywhere along the steering shaft. While the Powr-Steer operates as a servo mechanism between steering source and wheels, it also blocks and controls wheel shocks. Does not affect steering ratio. Maintains full and positive control through mechanical linkage in event of hydraulic power failure.

Specialized engineers in our Hydraulic Division are ready to adapt Powr-Steer to your specific needs in any of hundreds of machinery and equipment applications.

Can We Design World Weather?

Technology is closing in on this age-old problem. But scientists around the world can't get past the threshold of weather control because of a skyful of uncertainties.

NEW YORK CITY—Though weather control may be making news as a novelty, it's not yet thought of as a design market. But with meteorologists and other scientists close to important breakthroughs, control of weather may turn into a new field for designers.

An up-to-date rundown of where weather control stands now, what the hardware situation looks like, and what still has to be done, reveals potential for tomorrow's designers.

1 WHERE WEATHER CONTROL STANDS TODAY

Science is only at the threshold of weather control. Meteorologists can do little more than watch conditions build up, then trigger the weather action by seeding. They have three immediate aims: Dropping rain where it's needed, blocking buildup of damaging hailstorms, and killing electrical storms before they start. Seeding is the trigger in each case.

In brief, seeding theory states: moisture suspended in clouds is usually not heavy enough to fall as rain—it evaporates. But seeding a cloud can bring the moisture down by providing freezing particles of dry ice or silver iodide that act as nuclei, around which water particles coalesce to form drops.

Experimenters believe seeding can control lightning as well as produce rain. Because most cloud-to-ground lightning originates with large convective clouds, seeding to release moisture early in a cloud's life, and while it's still at a low level, should block buildup of potential—and resultant electrical storms. Hailstorms and hurricanes might be blocked the same way.

The President's Advisory Committee on Weather Control, in evaluating weather modification, found seeding of winter clouds in mountain areas increased precipitation 10 to 15%.

Tests to control lightening and hailstorms, however, have proved inconclusive. But results of cloud seeding "establish a firm basis for accelerated research that will most likely lead to a degree of control over the atmosphere," according to the Committee.

Unfortunately, funds for research do not fall as gentle rain. The Weather Bureau's request for $15 million for a five-year program to determine whether cyclones could be diverted has just been turned down. And much other research is considered too sporadic and uncoordinated for the job to be done.

2 MUCH EQUIPMENT ALREADY AT WORK

Weather control means two things: prediction and modification. Prediction, despite the jokes, is the more developed area. It makes use of equipment to collect, transmit and analyze data. But some apparatus has been developed for direct control and for experimental control work:

Silver-iodide generators. In the generator developed by Meteorological Research Institute (which offers a line of apparatus for weather observation and control), a 4% solution of silver iodide feeds from a container through an aspirator tube into a stream of propane. The mixture is burned at high temperature in a flame holder. Cooling baffles in the tube prevent the acetone from heating enough to cause vapor lock.

Portable Cold Box. This is used to study concentrations and effects of natural and artificial frozen nuclei. MRI's chamber is cooled from 5 to −35 C for the necessary tests. An air sample is forced into a chamber in the box and cooled. Then a vaporizer-humidifier adds moisture. If the air sample contains freezing nuclei, ice crystals will form around them. The chamber is cooled by a system using dry ice and alcohol. As the dry ice converts from a solid to a gas it cools the alcohol and forces it to circulate around the test chamber. The dry ice is vented directly to atmosphere when the test chamber is cooled.

Expansion box developed by Australian meteorologists is a device for counting ice crystals visually. The walls and base of the box are cooled to −10 C by liquid carbon dioxide. A tray with sugar is set at the bottom of the chamber. The chamber with the test air is closed and compressed until it rises to the temperature set by the experimenters. It is then allowed to cool to wall temperature of the box. When the air reaches wall tem-

Drs. Teller and Bush on Weather Control

Many scientists feel some degree of weather control is within grasp—if only funds were available for more preliminary basic and applied research. Their public statements reflect a sense of urgency, and hope.

Dr. Edward Teller told a Senate committee that Russia might reduce the US to a second-class power by controlling the weather to a point where they could deprive this nation of moisture. And said Teller, "I would not be surprised if (the Soviets) accomplished it in five years or failed to do it in the next fifty."

Dr. Vannevar Bush, of MIT, says, "It is entirely possible, were he wise enough, that man could produce favorable effects, perhaps of enormous practical significance, transforming his environment to render it more salutary for his purposes. . . In order to control meteorological matters all we need to do is understand them better than we do now. When we understand them fully, we can at least predict weather with assurance for reasonable intervals in the future."

perature, it is expanded. Ice crystals form and fall into the supercooled sugar where they can be counted.

Time-lapse camera. This is a field tool that photographs cloud formations at regular intervals. MRI's camera can be set to photograph at intervals between 1.5 and 15 sec. The camera has a 100-ft reel of 16-mm film, a timing-triggering mechanism to trip the camera shutter and a spring-wind device that winds the spring motor to hold tension. Meterologists are looking for a design improvement that will automatically control camera diaphragm so correct exposure can be maintained while camera is unattended.

Atmospheric-electricity recorder. This three-piece system measures and records electric potential at ground surface. MRI's recorder includes a rod tipped with radioactive polonium. The tips have low resistance and measure voltage in the surrounding air. Voltage on the rod is picked up by an amplifier whose output operates a recorder that charts a permanent record. The amplifier is nonlinear; it is sensitive to the mild electrical fields in good weather but can also measure intense fields during a storm. At about the half-way point on its scale, a stable element in the recorder's feedback loop alters sensitivity.

Computers, coming into use now in weather control, are expected to be the workhorse of both research and forecasting. The Weather Bureau has recently installed an IBM 704 at Suitland, Md., that will assemble data from around the country and use it to describe the broad circulatory air patterns at various altitudes. The reports will be passed to local bureaus to help with forecasts.

Radar is coming into increasing use, and aircraft, of course, are used where possible. The military services are acquiring valuable experience with these items as weather-control tools.

3 WHAT'S COMING IN WEATHER CONTROL

Despite the best efforts of the world's scientists, uncertainty is still the word that describes what we know about weather. Too little is known about the chemical and physical mechanisms of the atmosphere. Not enough is known about size, chemical structure, temperature, moisture content and radiation of clouds. Nor is enough known about water vapor and gases in the atmosphere, electrical fields, and ice crystals. Yet seeding is dependent on all of these variables.

Meteorologists face uncertainties on a larger scale, too. They know that weather patterns depend on absorption and reflection of radiation from the sun, and that the sun's radiation powers the earth's air currents. But they don't know how the earth's configuration, the atmosphere's composition, the moisture balance, and many other variables affect radiation.

That's why weather-control tactics over the next few years will be aimed at small modifications of local storms. More ambitious attempts have to wait for improved equipment design; especially needed are more precision and versatility.

The weather bureau would like to set up eventually an automatic system for information gathering and reporting. Data would be collected at observation points, teletyped to the central computer, analyzed to produce a basic weather map, and relayed to other bureaus for local forecasts.

Later, large-scale weather-modification efforts would be considered. These will "require methods that alter the large-scale atmospheric circulations, possibly through changes in radiation balance."

Artificial clouds might be maintained over some regions to act as reflectors. And evaporation might be controlled by spreading a monomolecular film of cetyl alcohol over water surfaces. This would adjust moisture balance.

The ultimate aim is to control the great air masses, to determine not only weather, but climate over great patches of the globe.

Who needs a skyhook . . .
for fire-fighting? This West German aerial stairway rises 203 ft (about 20 stories), can be elevated to 78° in 60 sec, and extends fully in about 2 min. Chassis has 180-hp engine, weighs about 24.5 tons. Telephone and walkie-talkie provides contact between ground and top of ladder Underside of stairway has elevator for lowering very old or very young. Revolving ladder comes equipped with a fire pump that has an output of 955 gpm at 113 psi. Builder is Carl Metz of Karlsruhe.

Coming: Hard, Flexible Nickel Electroforms

NEW YORK—Metachemical Processes Ltd, Crawley, England, has announced a new process for making extremely hard, flexible nickel electroforms. Company chairman H. Denis Hughes says the nickel tests at Brinell 600.

To make high-strength electroforms, Metachemical puts a plastic cover around the mandrel on which nickel is deposited in a plating bath. Grain size of the plastic sheet—it's actually 15% plastic, 85% conductive material—measures about 0.00002 in; grain size of the average metal mandrel runs around 0.003 in.

The tightly packed grain structure of the plastic sheet causes the nickel to build a fine grain structure, which greatly influences physical properties of the nickel. Annealing or cold working tests have not been made.

Metachemical produces electroforms to protect de-icer elements of airplane propellers from damage by flying rocks when the plane lands. The forms are cemented to the propeller with epoxy adhesives. Hughes sees many other applications of electroforms to protect surfaces subject to erosion or corrosion damage. Conceivably nickel coatings could serve as liners for chemical-process equipment, automobile bumpers, boat propellors or kitchen counters.

Jr. Rocketeer Savvy Spurs Army-ARS Safety Programs

NEW YORK—Don't underestimate the science-savvy of America's youth bent on building homemade rockets.

Letters, arriving at First Army Hq. on Governors Island at the rate of 10 to 20 a day show plenty of common sense and determined dedication. Here's a sampling:

"We think it would be a great idea if you would take the junior 'rocketeers' and merge them into one or two societies under Army supervision. Meetings would be held every weekend or so. This would help many a young man toward a career in astronautics and rocketry."

Another: "The fuels we are using are potassium nitrate, zinc dust, strontium nitrate, powdered magnesium metal, sulphur, and magnesium metal strips."

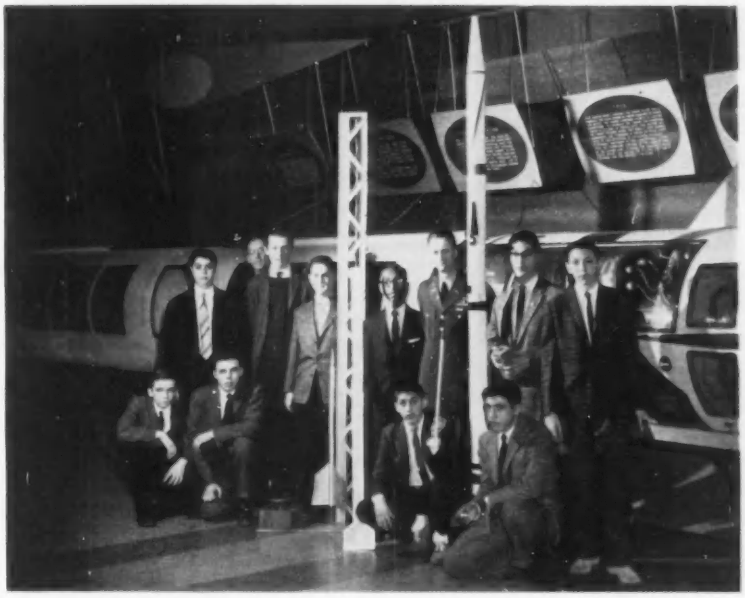
LOTS OF LETTERS

A third letter says, "After three years of preliminary research and development, I believe this missile ("Mark I") is the ultimate in amateur rocket achievement. It stands 9½ ft. tall, is 4 in. dia. Components include an 8-mm camera, radio-controlled parachute-release mechanism, recording instruments to measure atmosphere, and an airtight chamber to accommodate a living organism. Recent tests were made with a mouse."

Another lad laments, "Put yourself in the shoes of a 12-year-old boy who wants to become a scientist and is stopped because of no proving ground. Believe me, it is discouraging. Maybe someday I will be down at Cape Canaveral firing a manned rocket to the moon."

First Army is currently studying development of a program for amateur rocket builders that would include professional instruction in design and launching problems, and demonstrate all-important safety techniques for various propellants. A recent questionnaire to teenage experimenters in the metropolitan-N.Y. area indicates that many respondents have given little thought to potential danger in a misfire or an erratic trajectory.

To counteract the dangers inherent in rockets powered with match heads, which can quickly turn into a lethal bomb, Army is officially urging all youthful experimenters to halt unsupervised launchings immediately.



Wanted: one launching site . . .
for "Mark I", 9½ ft long Jr. Rocketeer missile shown at recent Hayden Planetarium meeting. Rocket, see photo, right, weighs approximately 60 lb, has cold-rolled steel housing for propulsion section, aluminum for instrument housing. Propellant (zinc sulphur) will give the rocket a 150-lb. takeoff thrust to send it up 5 miles in a 7 mile trajectory. Instrument package includes 8mm camera and special "mouse" capsule. Also, there's a parachute for complete unit recovery. Designer reports $500 equipment investment, approximately 1000 boy-hours of time. Other model units include miniature launching rack for smaller-scale projectile (left) and two midget hand-held jobs. Standing (background) is Capt. Bertrand R. Brinley, First Army Hq.

"We're not out to eliminate junior rocketeers," explains Capt. Bertrand R. Brinley at First Army Hq. "Instead, we hope that soon they will be able to get professional guidance in rocket design and flight testing through a coordinated program of supervised question-and-answer discussions, competitive model contests, and group launching meets." This activity would tie in with efforts of industry and educational groups and bring together some 125 amateur rocketeer groups that have indicated interest in professional sponsorship.

In Washington, non-professional rocket builders are getting help from the National Capital Section of American Rocket Society under direction of Lt. Col. Charles M. Parkin, Jr., Engineer Research and Development Laboratory, Ft. Belvoir, Va. The program includes supervised launchings at approved sites in the Washington area, and organization of several local rocket groups for youths.

Also in the works under ARS sponsorship is a book on amateur rocketry for use by model-rocket clubs.

Unique Power System

SCHENECTADY—Primary electric power for Convair's F-106 jet interceptor is supplied by two systems built by General Electric.

One, a unique d-c system, contains no brushes, collector rings, commutators, rotating field windings, reverse current relays or line contactors. It consists mainly of an inductor alternator with rectified output and permanent magnet excitation. It is rated at 100 amp., 30 v and 8000 rpm. The other, an a-c system, uses a high-speed aircraft generator rated at 12,000 rpm, 22 kva, and is oil cooled.

Plant and Equipment Additions Hit by Recession Signs

WASHINGTON—Observers here are seeing mostly bad news about the state of the recession—and the figures shown in the table here are among those that hit the economic planners hardest.

What they show is a sharp decline in the plans of business to build new plants and buy new production equipment—and the decreased spending, almost $5-billion less this year than last if present plans are carried through, contributes much to the business slide.

Here are some of the high points of the survey—and not all of them are bad news:

The decline is a slow one, with no sign that business men are calling a halt to all expansion.

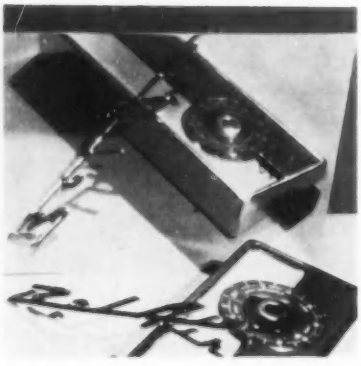
This year's estimate of spending is still huge by any standard—the third largest ever, coming below only the super-boom plant and equipment expansion of 1957 and 1956.

There are signs from some key industries that the reduced spending may be over by mid-year, and may start up again.

The survey, based on returns gathered largely in February by the Commerce Department and the Security Exchange Commission, is the first government effort to measure plant and equipment spending for the whole year. Last November, a McGraw-Hill survey showed business was planning a 7% reduction for 1958. The two surveys are not comparable; Commerce-SEC, for example, covers more small businesses. But the 7% decrease indicated last November, compared to the 13% drop in the new survey, can be taken as a rough indication of what happened to business planning as recession signs accumulated during the winter.

	1957 (millions)	1958 (millions)	Percent Change	1st Qtr. 1958 Estimate	2nd Qtr. 1958 Estimate
Manufacturing	15,959	13,196	−17	3,466	3,319
Durable Goods Industries	8,022	6,225	−22	1,707	1,575
Non-durable Goods Industries	7,937	6,971	−12	1,759	1,744
Mining	1,243	1,058	−15	270	284
Railroads	1,396	868	−38	298	225
Transportation, other than rail	1,771	1,440	−19	407	336
Public utilities	6,195	6,414	+ 4	1,466	1,723
Communications, commercial and other	10,398	9,098	−12	2,327	2,536
Total	36,962	32,074	−13	8,234	8,423

Source: Commerce Dept and the Securities Exchange Commission. Not seasonally adjusted.



Mirror, Mirror . . .

Alcoa's new high-luster aluminum sheet alloy (aluminum-magnesium-silicon-copper) got this finish by polishing and brightening before anodizing. Designated X5457 it is a companion to Alcoa's high-luster extrusion alloy, X6463. The new alloy has mechanical properties similar to those of 5357 and can be rolled to the same manufacturing specifications. Though the material will color anodize well, it was especially designed for natural color use to compete with chrome plating.

Another, and more direct indication, is a decline in expectations regarding the current quarter as reported three months ago and in the new survey. In December, the commerce-SEC survey reported business plans to spend at a seasonally adjusted annual rate of $35.5-billion this quarter. The new indication is for a rate of $34.0-billion.

For the year as a whole compared to 1957, every major classification of industry but one seems headed for a drop. The exception is public utilities—long a star performer in these surveys. Some $6.4-billion of new capacity will be put in place this year if utility executives carry through with their plans, up 4% over 1957.

Here is the trend for the other major groups:

Durable goods manufacturing— Down 22%
Nondurable manufacturing— Down 15%
Mining— Down 15%
Railroads— Down 38%
Other transportation— Down 19%
Commercial, communication and other— Down 12%

French Speed Engineer Study

GRENOBLE, FRANCE—France is planning a determined effort to overcome a critical shortage of engineers for the atomic age with night classes for workers at its universities.

The pilot scheme has been going here in Grenoble since 1951. Soon it will be extended to the universities of Nancy, Toulouse, Besancon and Aix-En-Provence. Eventually 30 centers are expected to turn out 1,000 extra engineers a year.

The French lack of engineers is serious. Charles Malegarie, a state highway engineer, recently told the Academy of Moral and Political Sciences that France handed out only 4,000 engineering diplomas a year, while the U.S. trained 75,000, Great Britain 12,000, and Russia 165,000.

The idea launched here in Grenoble is to educate workers who have practical experience but have never studied the theory behind what they are doing.

Each year 200 workers, from 20 to 40 years old, have two-hour courses nightly after finishing work. Those who come from outside Grenoble or its suburbs work all day Saturday and Sunday morning. The courses total 14 hours a week and, for each hour of lectures, there is 1½ hours of practical work. English is obligatory.

Plastics in Cars on the Upswing

- **Gears, bushings, seat covers, inside and outside trim, prime coats are but a few automotive uses of plastics today.**
- **Foresee 60 lb. per car in 1965; compared with 20 lb. today.**
- **Molded bucket seats, instrument panels, a high temperature resistant, high impact strength phenolic premix are some new developments our Detroit Editor, Felix Giordano, sees for the future.**

DETROIT—Big and small alike, the automobile companies are convinced that a new age of plastics is at hand. They see the signs in the stepped-up cooperation between the chemical companies and their own engineers, and in the increased public acceptance of the new plastic materials.

Over the last 2½ years, and increasingly in the last six months, chemical companies producing plastic raw materials have established consulting services to the automotive trade. In each case this service is separate from the selling function, some companies even going to such lengths as to house them in different buildings.

These groups act as advisors to the automotive engineers and designers in choosing the right material for a given application, or in discouraging the use of plastics altogether where they fear it might make a poor showing.

They also act as intermediaries between the automotive companies and their own research and development organizations, transmitting the problems that cannot be solved with available plastic materials. This often results in new materials, tailor-made to the given application.

This new acceptance by the automotive people is fundamental. In some instances, several auto makers are still afraid that plastics might cheapen their product in the public mind. These companies have given their acceptance almost grudgingly and piecemeal, using the new materials in individual applications and mostly as replacement for older, established materials. This sometimes forces the plastics into a design to which they were unsuited, mostly because of the cost factor.

The situation has largely changed, especially through the increased use of thermoplastic materials. And the automobile manufacturers, who in the way of materials generally follow rather than lead public taste, have started to go along with the new trend for plastics, helped by new developments in materials and in manufacturing methods.

One large producer of plastic raw materials foresees the 1965 car as using between 50 and 60 pounds of plastic as against the present 15 to 25, and 1939's 2 to 3 pounds. But some people feel that this forecast is on the conservative side.

THE PLASTICS HOLD ON

Once plastics become entrenched in a particular application, they are hard to dislodge, mainly because of the cost factor. Thus, every addition is a net gain. Metals—die castings, for example—have to fight tough competition from other metals to keep the job.

In some applications plastics have been used almost from the beginning, as in rotor housings and covers, difficult—and much more expensive—to produce otherwise.

In the replacement field, plastic coverings of electric wire were among the first to utilize color for assembly purposes, saving time and money in connecting wire harnesses to the increasing number of terminals. This application of color has since been utilized by other branches of industry for identification, especially of sizes, as in small plastic gears, permitting assembly by color schemes.

One big chemical company has established a grant to a well known engineering and art school. Students prepare prototypes of projects involving plastics in automobile design. Engineers and stylists are then offered both. Some applications started that way.

Offering service to the automotive industry, Bakelite, Du Pont, General Tire & Rubber Co., Monsanto, and Rohm & Hass have set up engineering consulting offices in Detroit.

THE FIELD FOR PLASTICS

In the automotive industry, plastics application is dependent on the properties of the materials, the engineers' familiarity with them and the planners' estimate of buyer approval. In strictly functional parts, it is fairly easy to convince the engineer when the plastic can do as well as, or better than another material.

Gears are a widening application, within the limitations of the plastic used. Recent uses include the automatic antenna elevator, windshield wipers and electric window actuators. Glass reinforced molded phenolic gears are used by two automotive companies in automatic transmissions because of the ease of molding to strict tolerances, ability to withstand transmission oil temperatures up to 350F, dimensional stability, and the frictional properties that can be utilized in the "running in" of the mating surfaces.

Bearings and bushings also offer a wide field. Already in use are steering column bushings, brake and clutch pedal suspensions and linkages, brake cam shaft bushings, kingpin bushings, and main hanger bushings for torsion bar suspension on trailers. This type of application is on the increase.

Plastic window mechanisms include window crank handle bearing plates, window regulator rollers, antirattle plates.

Electrical applications are in voltage regulator bases, lamp sockets for attaching to printed circuits in instrument board lighting, fuse holders, connector covers.

Transparent plastics are used for outside and dome light lenses, for interior dials, for medallions. Plastics with good impact properties go into the back stops of front seats in two-door cars, and in door striker wedges. Esthetic as well as functional are the plastic buttons in some push-button shifts.

Plastics, are used on the piston rings and seals of power steering units, and on the bearing surface on some carburetor choke plates. A laminated phenolic thrust washer was an improvement on a metal washer in a planetary gear system. Reinforced

teflon hose is used on the high pressure side of the air compressor in air suspension systems, and other tubing.

Some applications are in an in-between state. Certain types of nylon have useful properties for oil and fuel line applications, but need to be mixed with compounding materials to ease extrusion and give adequate life. These materials have been developed, as have special fittings.

FABRICS

Some plastics get on the car after it is delivered to the customer. See-through and other plastic seat covers are in this class. Similar plastic materials find application in original upholstery. Nylon yarn produces much of the cloth used.

Saran, now being produced in fine yarn sizes, is expected to hit the market soon as woven fabric. It is so resistant to stain that it cannot be dyed. Color will be included in the materials before the filament is spun, making color matching easy, and avoiding streaks in the woven material resulting from uneven dye absorption.

CAR FINISHES

Priming coat in the 1958 Lincoln is a water soluble styrene butadiene latex applied by dipping the automobile shell in tank. The method easily reaches parts of the car that would be otherwise difficult to coat, also eliminates the need for flammable and explosive solvents, and reduces hazards and the cost to control them (ventilation, water walls). Water emulsions of latex paints are being developed for glossy finish coats.

REINFORCED PLASTICS

Reinforced plastics (with fiberglass, sisal) have opened new possibilities. Polyester premixes are used widely on the molding of heater housings and ducts. Fiberglass reinforcement made possible a plastic hard top, more recently a hood, and is expected to find another use, i.e., a trunk lid. Styrene acrylonitrile copolymers are in housings for car air conditioners, and battery hold-downs.

Foams are in seats, crash pads, sun visors. Films and sheeting serve as weather barriers to protect upholstery, and are used for parts packaging.

Metalizing makes mylar film attractive for decorative use, and has opened the market for one-shot vinyl moldings, like dome lamp brackets.

WHAT'S COMING

The list of applications is long, but the plastic industry feels it is only on the threshold of a real breakthrough. Partly, they see future expansion in new materials. One executive points out that many materials in use ten years ago would not be suitable today and that the plastics industry is in a continuous process of improving its products, developing them to specific properties to suit the car makers.

- A phenolic premix almost ready to market will have heat resistance between 300 and 400F, high impact strength, water resistance (less than 1% absorption), specific gravity as low as 1.33, wide variation in formulations and physical properties.
- New phenolic impregnated sisal mats have strength, toughness, dimensional stability, low cost. Possible use: instrument panels, bucket seats.
- Laminating expensive top sheets, that are resistant to weather and hydrocarbons, to inexpensive, easily fabricated bases can solve both costs and weather problems. This does not need extensive development.
- Post forming and post treating of plastic parts offers many possibilities.

Most of all, the future lies in the engineers' acceptance and increased use of the fundamental characteristic of plastics: ability to form. An engineer from one of the leading chemical companies puts it this way:

"Plastics will come into their own when engineers will learn not to use them like metals or other materials. Now the engineers are accustomed to cut and assemble; plastics should be formed in one shot."

As an example, he pointed to door liners. Plastics are used there now, but they are strips and pieces that have to be assembled, the seams to be covered with trim—an expensive process. The whole liner could be molded in one piece, arm rest and all.

Speaking of doors, the same engineer went on: "You could go further, mold the whole door out of plastic, with glass and window crank mechanism in place. It would need a minimum of trimming and finishing. It would cost so little that if anything happened to it, it would pay to throw it away and get a new one."

Now—a Tape-controlled Production Line!

LOS ANGELES—Automatic electronic control has been successfully applied to a series of machine tools on successive operations, and can make a variety of parts simply by a change of tape without stopping the machines. Hughes Aircraft Co. here, working with Kearney & Trecker Corp., Milwaukee, demonstrated the new Digitape system applied to a milling machine, a drill, and a boring machine in a single production line.

ONE OPERATOR

The prototype line is actually producing parts for electronic armament-control systems for interdeptors. One operator handles the entire line; he loads and unloads and changes tapes as needed. Tapes can be punched by a typist after a few hours of instruction. Digitape is a straight decimal system, not requiring either a computer or a conversion code. Setup is easy because only one fixture is required per part and operations are essentially single-point cutting. Changes are made simply by changing tape and fixture in many cases, thus no finished-part inventory need be carried. Variations caused by tool wear are dial-adjusted. Machine units are modular so machines also can be interchanged.

Three fixtures are in work simultaneously and one being loaded. Four tapes are used—one per fixture—for maximum production in this case. The transfer unit operates only when all machines have completed their tape-controlled cycles.

Nineteen types of electronic-circuit building blocks or assemblies comprise the control panels.

Machine bases and most of the elements are standard. Each of the three standard bases provides tape-controlled three-dimensional feed movements plus one or more controllable spindles. Interchangeable barrels or heads, one on each basic machine, hold tools for milling, drilling or boring. Barrels may be easily changed in several hours.

As presently operated, the line consists of a transfer bed carrying parts on fixtures past the three horizontal machines in turn, in the order: miller, drill, boring machine.

A-Plant Competes with Conventional Fuels

SAN FRANCISCO—Pacific Gas & Electric Co. plans to build a $20 million atomic-power plant near Eureka that will generate power at a price competitive with local steam power. The plant, though rated at 50,000 kw, is expected to generate 60,000 kw. Steam will be produced by a boiling-water reactor. Fuel will be 2%-enriched uranium oxide pellets clad in zircaloy. Fuel life is estimated at between 3½ to 4½ years.

The new facility will be designed and built by Bechtel Corp. on a fixed-price turnkey basis, the first contract of this type for a nuclear power plant. Nuclear and electrical equipment will be supplied by General Electric who will also produce the fuel at its new San Jose plant. PG&E expects power costs on the first core to be 8.7 mills. By the time the plant is operating on the second core, improvements in fuel and fabrication process are expected to lower costs to 8.1 mills.

This figure is low compared to coal-fired plants, and quite low for nuclear plants. The factor to be considered is that this plant will operate at a 90% capacity factor, which is high. Conventional plants operate at a 65% load factor. Figured on this latter figure, the nuclear plant cost would be 12 mills per kwh. Conversely, if the best oil or gas-fired plant was operated at a 90% load factor, its costs would be reduced to 6.5 mills. The Shippingport nuclear reactor is operating at 65 mills per kwh—quite high, but valuable data is being gained for future nuclear plants.

Although nuclear-plant costs will nearly double those for a conventional installation of the same capacity, fuel cost savings are expected to approximately equalize over-all expenditures. A factor that makes nuclear power competitive in the Eureka area is the high cost of conventional type fuel there.

Stronger Magnesium Extrusions Coming

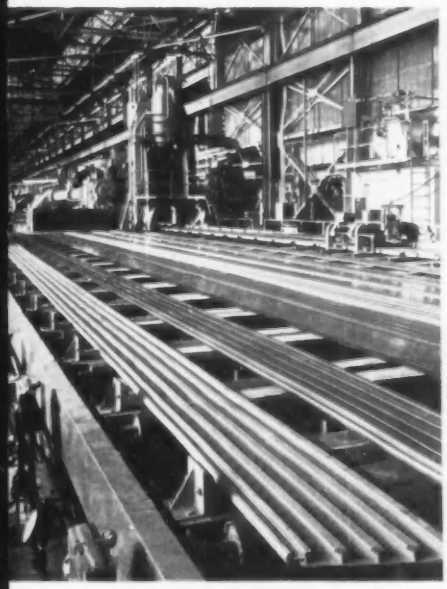
MADISON, ILL.—Dow Chemical Co. has adapted pellet extrusion to its 13,200-ton press, world's largest for extrusion of magnesium.

For nearly two years Dow has been using its smaller presses to extrude pellet material into sections with guaranteed minimum compressive yield strength of 35,000 psi, in cross-sectional areas up to 10 sq. in. These sections are about 40% stronger than those extruded from billets.

Company officials believe pellet extrusions from the big press offer comparable strength in cross-sectional areas up to 20 sq. in. Dow is about to begin pellet-extruding the first commercial order with dimensions large enough to require the big press—loading-ramp flooring sections for the C-133A air transport.

Extra strength of pellet extrusions, according to the company, stems from their extremely fine grain size. The pellets, atomized from molten magnesium, average 0.016 in. in dia.

Dow's press can produce integrally stiffened magnesium or aluminum sections up to 20 in. wide; I-beams as high as 28 in., and round tubing up to 24 in. OD.



Giant magnesium extrusions . . . for aircraft landing mat lie on runout table of Dow's 13,200-ton press.

Bits and Pieces

LOOK MA, NO WHEELS!

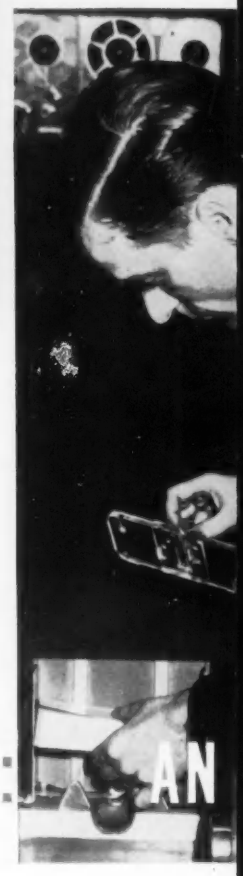
According to Carl Reynolds, a Detroit product designer who played a prominent part in the design of the automobile tail fins, this (see left) is the car of tomorrow, and it isn't far off. Propelled by ducted fans, the car would maintain an altitude of two feet. It could climb to 100 ft., but should be controlled to prevent hedge-hopping. A gas turbine engine would be used. Eliminated: wheels, springs, bars, shock absorbers. . . . Greater utilization of engineering talent is necessary to compensate for the coming drop in the male labor force which will result in 700,000 fewer men aged 25-34 in 1965 than we have right now, is the comment of the president of the Professional Engineers society. . . . Sperry Gyroscope Co. with a $21-million development-production contract, becomes system manager and prime contractor for the production of high powered radar sets. . . .

NO MORE ASH CANS?

According to Albert Olevitch, Air Materials Lab, WADC, packages in which food and other supplies will be packed will be edible, probably in the form of vitamin-loaded chemical films. Big consideration here is for weight reduction in space travel.

The National Bureau of Standards has been experimenting with the processing on digital computers of information on pictures. With the necessary scanning and display equipment, the computer converts pictures into digital form suitable for input to SEAC, processes it according to some prearranged routine, and displays the results as a visual output. . . . Red China is due to turn out its first car, reportedly a 4 or 6-cylinder model having 5 to 6 seats. . . . Work in the IGY program has shown that magnetic fields at the sun's surface may be very high—as much as 8,000 times that of the earth's field at the equator. These magnetic fields are thought to play an important role in the disturbances and storms on the sun's surface as well as in sunspots. . . .

MI PYERYEDAYEM MISLYI POSRYEDSTVOM RYECHYI . . .



Have we got a good one yet? If not, what's all the holdup? What's so difficult about it? How would it work anyway? Answers to these and other questions are becoming more and more important to engineers and scientists. Here is a simple survey of the complex problems involved.

THE TRANSLATING MACHINE: AN

DOUGLAS C. GREENWOOD, Assistant Editor

■ A few weeks before the atom bomb was dropped on Hiroshima, a fateful message was sent to the Japanese. We knew what lay in store for their country if we had to use the bomb. In all sincerity we could but try to warn them and hope they might realize they must surrender. So the Potsdam ultimatum was sent. The Japanese reply hinged on one word, *mokusatsu*.

This word has two translations. One is "to refrain from comment"—the meaning the Japanese intended. Their Cabinet was actually considering the offer but wanted more time. Instead, the crucial word was translated "to ignore," which made the reply read "The Cabinet intends to ignore the demand."

This semantic misunderstanding was probably the most hideous in human history. It is also an example of an obvious difficulty—the chief obstacle—we face when trying to translate by machine. It explains, in brief, why we don't yet have a machine that can translate unambiguously—as accurately as a human translator.

This ideal of mechanical translation—usually abbreviated MT—is, however, so high that it may never be achieved. Especially in the light of one observation that any translation, no matter how good, is "like kissing through a veil." We may have to settle for something less perfect but still good enough.

Three main platforms are involved in the climb to success in MT. They are

1. Lexical
2. Syntactic
3. Semantic

They can be suitably discussed separately. But first a brief description of the machine itself.

A *THE MACHINE*

The type of computer suitable for translating is a data-processing machine. This consists at present of a card punch and reader, a processing unit, and an output printer. The card punch is fed from a typewriter upon which the foreign language is typed by a human operator. Lengthy documents can be split up and farmed out to more than one typewriter. Holes punched in the cards represent individual letters, spaces and punctuation marks expressed as binary digits.

The cards are stacked in the card reader and their information fed to the processing unit that compares this input with master data stored on a permanent-memory drum. Output from the processing unit is fed to a printer. The translation appears on the paper coming from the printer.

. . . WE TRANSMIT THOUGHTS BY MEANS OF SPEECH

So far so good. But by what magic does the processing unit translate? Therein lies the rub. It is not magic. It is an ingeniously devised set of complex instructions —programming—fed onto, and stored on, the memory drum. This programming, in turn, is backed up by titanic feats of research by mathematicians and linguists into the very roots and structure of human languages.

And their research is still far from reaching bedrock.

B *LEXICAL—Word-for-word Translation*

Armed with a Russian-English dictionary, a person entirely ignorant of the Russian language could come up with a literal translation of a Russian document. It would not, however, be of much use. It would be something like this:

"(In, At, Into, To, For, On, N) (last, latter, new, latest, lowest, worst) (time, tense) for analysis (and, N) synthesis relay-contact electrical (circuit, diagram, scheme) parallel—(series, successive consecutive, consistent) (connection, junction, combination) (with, from) (success, luck) (to be utilize, to be take advantage of) apparatus Boolean algebra."

All the alternative translations for the Russian words are in brackets. It is obvious that the message would not be getting through!

The correct translation is: "In recent times Boolean algebra has been successfully employed in the analysis of relay networks of the series-parallel type."

The translation is from a Russian paper on "The Application of Boolean Algebra to the Analysis and Synthesis of Relay Contact Networks," published in 1950. If we had known the paper's complete contents, we would have saved about five years' intensive effort on the problem.

Word-for-word translations can be easily done on a data-processing machine. A Russian "dictionary" in the form of magnetized areas representing words is stored on the memory drum. Input to the processing unit is compared with the data on the drum. When they agree, the output from the processing unit appears as an English word at the printer. Or it is even possible to arrange for the output to appear as a word on a cathode-ray display tube.

Lexical translations might enable a person to get a rough idea of what technical area is being discussed. He could then have a better translation made if he thought it worthwhile. But that is about as far as it can go. Something less foggy is obviously required.

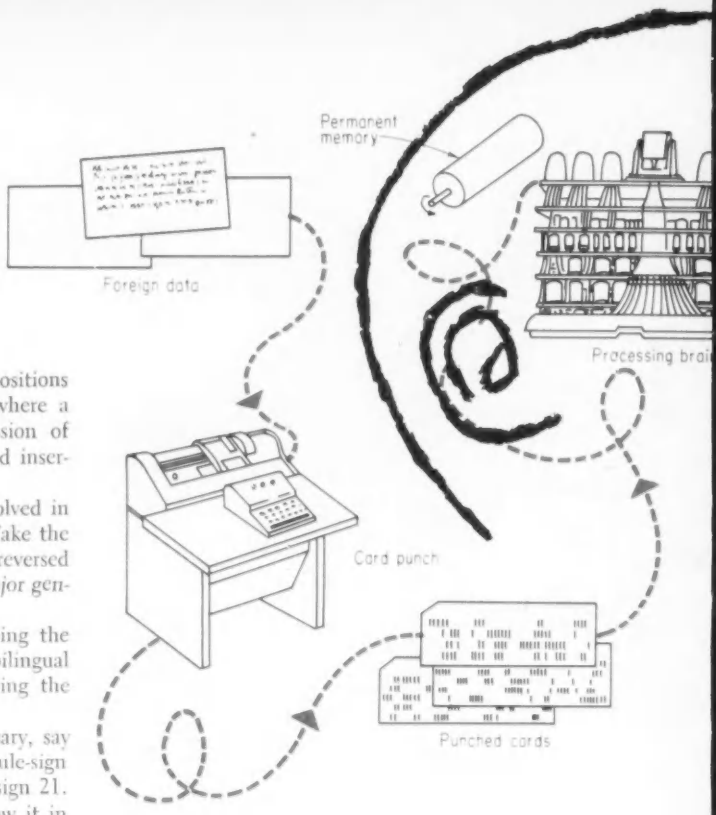
Can this be done? It can be partly accomplished by taking into account the grammatical structure of the language concerned.

C *SYNTACTIC TRANSLATION*

Linguists, working with programmers, have been able to devise certain rules of syntax that can be fed onto the memory drum along with the "dictionary." This might be looked on as a sort of further education for the electronic brain. Four years ago, at the Georgetown University Institute of Languages and Linguistics in Washington, an IBM 701 computer was used for such a test. What the programmers did was create virtually an entirely new electronic language. They took normal words and attached to them tags or signs that gave each word a precision it did not usually possess. These signs denoted rules of grammer and meaning. Although only six rules were used in the experiment, they were enough to cover all the words the machine was asked to translate. The particular six rules were chosen because they had a broader effect on language translation than any other rules studied by the Georgetown linguists. Dr. Leon Dostert, in charge of the test, estimates it may take as many as 100 rule-tags to translate scientific and technical literature in general.

But no matter how large the number becomes, the

THE TRANSLATING MACHINE



six will remain basic. They govern word transpositions required to make sense, choice of meanings where a word has more than one interpretation, omission of words not required for a correct translation, and insertion of words required to make sense.

Here is an explanation of the mechanics involved in operation of the rule governing transposition. Take the Russian words *gyeneral mayor*. They must be reversed to arrive at the proper translation in English: *major general*.

The switch is assured in advance by attaching the rule sign 21 to the Russian *gyeneral* in the bilingual glossary stored in the machine, and by attaching the rule-sign 110 to the Russian *mayor*.

The stored instructions, along with the glossary, say what amounts to this: "Whenever you read a rule-sign 110 in the glossary, go back and look for a rule-sign 21. If you find a 21, print the two words that follow it in reverse order."

So the machine obeys, and it's all done in a fraction of a second.

One other example: The Russian word *nauka* means *science*. The Russian word *o* can mean either *about* or *of*. The proper English translation of *nauka o* is *science of*, not *science about*. But how can the machine know that?

In its Russian-English glossary, *nauka* has affixed to it the rule-sign 242, and *o* carries the rule-sign 141. And the instructions on the memory drum say "whenever you read the rule-sign 141, go back and look for 241 or 242. If you find 241, select the first English translation and print both words in the order in which they appear in the Russian sentence. If you find 242, select the second English meaning." Consequently, when the computer is given *nauka o* to translate, it reads the 141, looks for and finds the 242, chooses the second meaning given for *o* which is *of* and prints correctly *science of*.

This computer translated Russian at the rate of one full sentence every six or seven seconds. Only 250 different words were used in the test. Although Dr. Dostert phrased it "a Kitty Hawk of electronic translation," many problems are yet ahead. For instance, the formulation of logic required to convert word meanings properly, even in a small segment of two languages, needs 2½ times as many instructions to the computer as are required to simulate the flight of a guided missile.

More recently a group at Georgetown University has devised a new programming method. (*PE*—Dec. 23, '57 p.85). This method will be tested at Washington soon. An IBM 705 machine will be used to translate a 30-page Russian paper on chemistry. The electronic "dictionary" has been stepped up from 250 to 2100 Russian words.

However successful this latest test, there is still a long way to go. Machine storage-capacity is one limiting factor. For example, in the largest English dictionary, there are about 500,000 words, with an average of two to three derivations for each. Russian has about 100,000 words, with 10 to 15 derivations each. Other languages are similar. That means well over a million words per language.

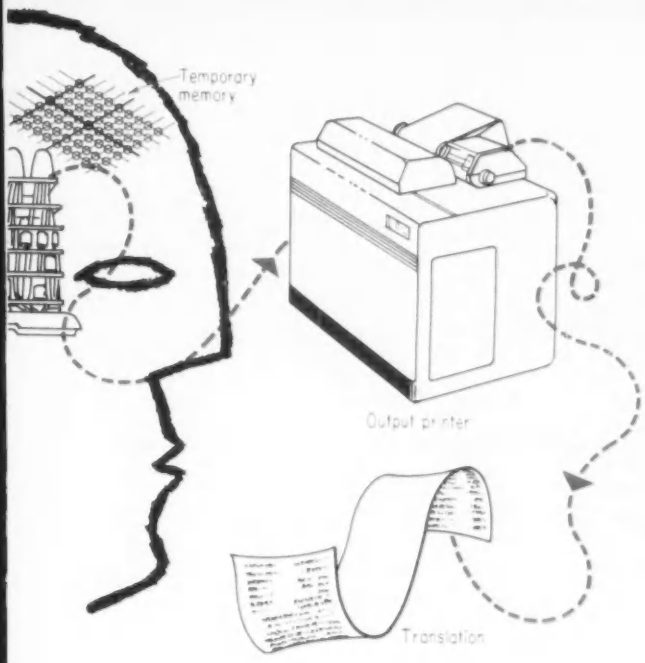
The largest storage capacity at present for a quick (1/50-sec max for any word) access, magnetic memory is only about 6,000 words per drum. Up to 30 drums could be coupled together—if cost were no object—to hold 180,000 words. (Magnetic tape can hold more, but search time is at least 10 times as long).

However, fewer than 50,000 words would probably cover nearly all those actually in an average paper. This figure can be reduced to about 5000 word-stems plus a few dozen affixes.

The translating machine can be arranged to strip the input word-ending until the root is recognized. The inflectional ending—such as -ing to write- is then compared separately and added to the root to give "writing" at the output.

D *SEMANTICS—"We will bury you."*

There is a fairly common Russian phrase—"We will hold a funeral over you." It means "We will still be here after you're gone," or "Communism will out-



live capitalism." Without holding any brief for Khrushchev it is felt that quite possibly this is what he meant to imply—rather than the apparently bloodthirsty sentiment that gained credence in the press.

Such ambiguity is a result of wrong interpretation of an idiom rather than a single word. But obviously, single words can cause just as much confusion. How, for instance, will a machine know the difference between "screw" and "propeller"? A human interpreter could go by context. If the translation read, "The stripping strength of propeller threads varies with steel strength," it is obvious that "screw" is the word rather than "propeller." Such knowledge can be programmed into the machine by considering the probability of "screw" appearing with certain other words in the same sentence. This might seem to imply being wise after the event. But if the technical area of the paper be known—e.g., mechanical as opposed to aeronautical engineering—it is likely that the probability tool is valid.

This example, however, is greatly oversimplified. And even this simple application of probability theory to the concept of meaning would require difficult programming.

The arrangement of words according to probability, where the probabilities depend on previous words, is known as an *ergodic process*. Analysis of the theories involved in such processes is so deep and complex that it has taxed the efforts of the best mathematicians. But therein might lie the answer to how semantic accuracy will be achieved in machine translation.

E *FUTURE DEVELOPMENTS*

Different methods of feeding the language into the computer are being researched. For instance if the machine could actually "read" printed characters, that would cut out the typing. To a limited extent this has been achieved; there are now machines that can "read" numbers. Check-reading machines for banks have distinct commercial value. The Intelligent Machine Research Corp. has actually built a machine that can recognize the letters of several different type fonts as well as typed addresses on mail. Automatic recognition of handwriting is not so far advanced.

A machine that identifies spoken words has been named, in hopeful anticipation, a "speech typewriter." Such a machine's commercial value is, like the check and address reader, unquestionably high—apart from any translation application. There is thus hope that research funds will be available in quantity for these developments.

Bell Laboratories has already built AUDREY—the Automatic Digit Recognizer. This machine identifies numbers "zero" to "nine" when spoken by a male voice. Progress is at a snail pace, however, for the problem is an Everest of complexity.

Research is proceeding on the hypothesis that, as there is a finite number of different sounds in any language, some physically measurable characteristics must exist. For instance, there are about 40 different sounds, or *phonemes*, in spoken English. (No standard phonetic alphabet has yet been invented, however. Bernard Shaw left $23,240 in his will to promote development of an efficient, phonetic alphabet). These phonemes may each have a standard pattern that would enable it, and thus words built up from phonemes, to be recognized by a machine.

When will we have really efficient MT?

Five years for typewritten input is one estimate. For "reading" and "speech recognizers"—pure guesswork gives 10 years.

One big help would be a sort of basic construction style for technical writing that would be universally agreed upon. But this idea is obviously futile.

Oddly enough, though, for a large class of technical writing, there actually is, by accident, a common pattern. The long, passive sentences of academic prose; its preference for subjunctive moods and subordinate clauses; its long words where shorter ones would do—all add up to a pattern. Machine translation could take advantage of this pattern.

This article has been written to modern journalistic standards. Therefore, a Russian translating machine programmed for "academic" writing would have a tough time. Sorry, comrades! ■

POINTS

THE QUESTION:

Who Should Have Responsibility for New-product Planning?

HUGH L. CLARY
President, Clary Corp.
San Gabriel, Calif.

"The customer does the new-product planning . . .

We find out what the customer wants and needs, then build it. We have scores of men in the field, all of whom have been specially briefed to keep their eyes and ears open for new-product possibilities based on needs they see exist and hear expressed.

"Our salesmen and engineers naturally spend a good deal of time in companies talking to executives. We have seen heads of big corporations shudder when they see electronic equipment representing investments of hundreds of thousands and even millions of dollars standing idle. And we have heard executives in small and medium-size firms express a desire for a computer which would perform many of the repetitive problems of business at a cost they could afford. These people, unknowingly, designed our Electronic Computing Machine for us. . . ."

CLARK CRAWFORD
Coordinator, Pyroceram Products
Corning Glass Works

"New products are so vital . . .

to the growth of a company that the entire organization must share the responsibility for their development. However, only the chief executive can define the corporate goals, establish product policy, and provide the perspective required to judge investment risks. He establishes the favorable development climate and stimulates all personnel by his continuing interest.

"As the company grows, the pressure of current business makes it increasingly difficult for the executive to give long-range product planning the systematic attention required. To make sure this is done, he often assigns the determination of facts, the recommendation of the program, and the coordination of development, once approved, to either a full-time staff member or committee. However, the executive alone retains the decision-making responsibility at the divisional as well as the corporate level. In case of product diversification within the division, an additional assignment may be advisable for each major product line.

"Most important is that the need for a long-range new-product plan be recognized, that a systematic determination of facts and programs for executive decision be organized, and that continuous follow-up be maintained so that the approved program reflects current conditions and works as the management plan for future profits."

OF VIEW

"The Sales Department . . .

should be responsible for new product planning, preferably under the direction of the chief Sales executive, where it can obtain top-level guidance and attention. Sales is best equipped to guide a company in the new-product area through intimate knowledge of the needs of the market. Market demands should have a significant effect on the basic design approach, quality level, and financial needs of a proposed new product. Sales also can and should coordinate product planning as it affects the decisions of the Engineering, Manufacturing, and Financial Departments.

"New-product planning is best handled as the responsibility of a separate section or manager, such as a Product Manager, Product Development Department, or even a New Products Department within the Sales group. Responsibility and authority of this group should be well-defined, and adequate financial and manpower support provided, to produce first-class results. Only the constant, comprehensive attention such a group can provide will produce the best results in terms of profitable new products."

DOGAN H. ARTHUR
Vice-president Sales, Titeflex, Inc.
Springfield, Mass.

WILLIAM E. ROBERTS
Executive Vice-president
Bell & Howell Co.

"New product planning . . .

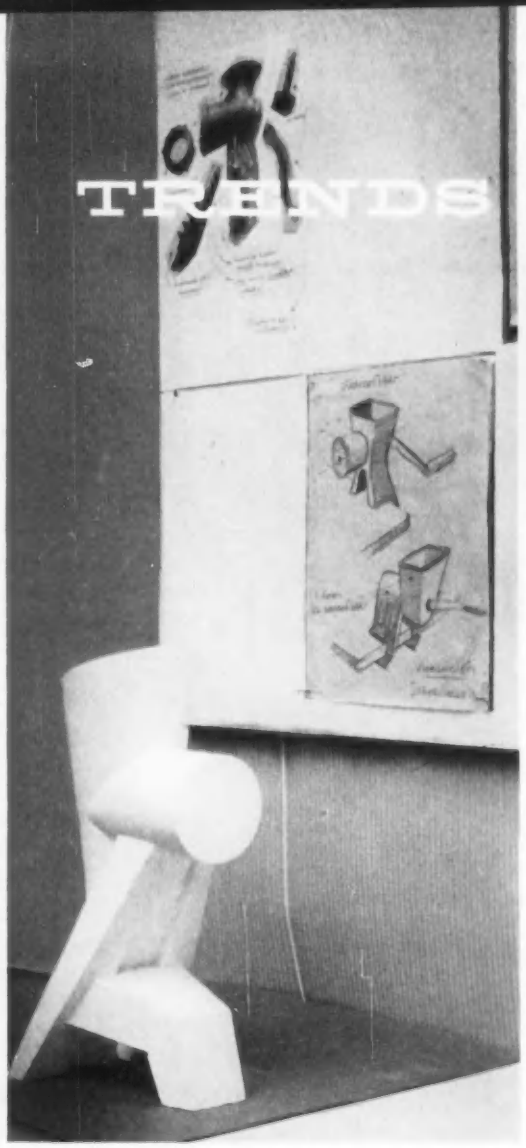
is and should be a major responsibility of all of the company's top executives, operating within the framework of previously established long-range and short-term goals. At Bell & Howell this is accomplished through an advisory Research Board, consisting of the president, executive vice-president, treasurer, the heads of the engineering, manufacturing and marketing divisions, and the chief of the product development group. All new-product ideas, wherever they originate, are first submitted to this board, so all key personnel are able to contribute their viewpoints.

"Market research and merchandising ideas on feature, appearance and price are usually obtained before the first sketches of a new product are committed to paper. Sales, engineering, manufacturing and financing problems are reviewed before, not after, new product development work is started. When a project is given the go-ahead, it is assigned to the proper operating division. But the Research Board continues to keep track of progress, so that design engineering and manufacturing—and particularly production engineering and tooling—can be coordinated early. This solves many manufacturing problems before the final design is released by the engineering department.

"Since new products are the lifeblood of progress and involve all departments of the business, the best ideas of the best men in all divisions should be brought to bear on product-planning problems. To operate successfully, this plan assumes that the work of the top men in each division will be so organized and delegated that they have available the time needed for the all-important product-planning function."

TRENDS in appe

OIL HEATER was designed by W. Gilles for DRU.

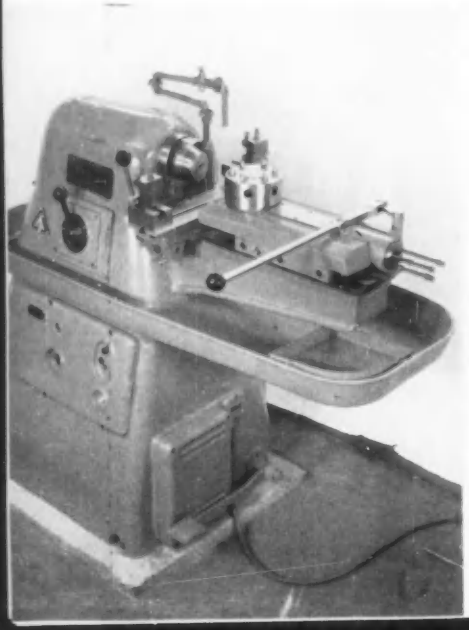


SKETCHES are of present food mill and a student's proposal for redesign. Three-dimensional shape study is from this same project, at Holland's new Academy for Industrial Design.

AUTO BODY is also by students of the Dutch industrial design academy.

COFFEE GRINDER is by W. Jaarsveld, for De Vecht.

WEIGHING MACHINE, A. G. C. van Westvenen, for Oiland N. V.



CAPSTAN LATHE, left, was designed for N. V. Nederlandshe Machinefabrik. Heavy-duty lathe, right, with copying attachment, is made by same manufacturer. Both machines designed by group known as Artillerie Inrichtingen.

arance design... IN HOLLAND

SECTIONAL, OR JOINTED, STREETCAR, shown in service on Amsterdam street, was designed by F. Kramer and G. Penraat for Beynes.

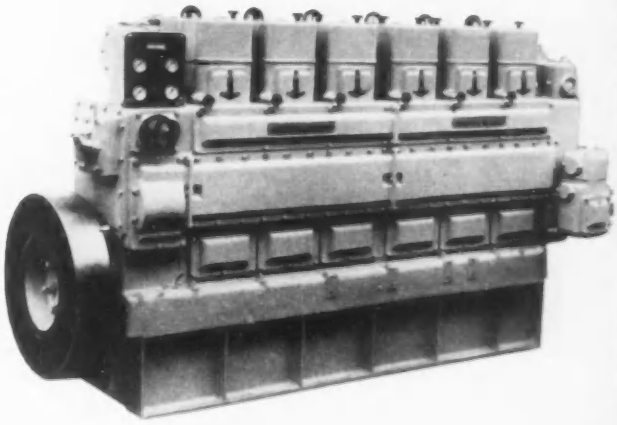
Design consciousness is sharply on the increase in Holland, where much headway has been made since 1950. In most enterprises, the notion, "Why change our products as long as they sell?", has made way for more advanced ideas. Progress is being made quantitatively (in the number of enterprises employing an industrial designer or consultant designers) as well as qualitatively.

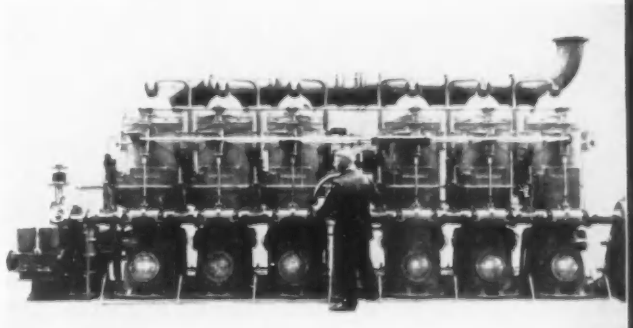
The Dutch designer, with some exceptions, is still comparatively unknown abroad. This is because very few Dutch manufacturing enterprises have products on the world market in significant amounts. However, the newly founded European Common Market should create a bigger outlet for Dutch industrial products. Design in Holland will then play an increasingly important role.

The fledgling Academy for Industrial Design is an example of how recently concern with design has developed in Holland. The Academy was established only two years ago, in 1956. It offers a full-time course of four years and one practice year. The Academy begins on a secondary-school level and includes a general education. At present there are about 30 students (10 per class). Its establishment at Eindhoven (Philip's headquarters) means that the direction of the courses is highly technical.

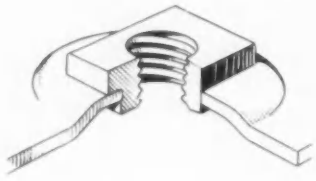
The Association of Industrial Designers was established in Amsterdam six years ago. This association now has some 35 members. All of them are practitioner-designers either employed by an individual concern or as free-lance consultants. Each must have at least two years of professional practice and at least one design product under his name. The typical designer-member of the Association has a thorough knowledge not only of drawing and art, but of engineering, industrial techniques and marketing as well.

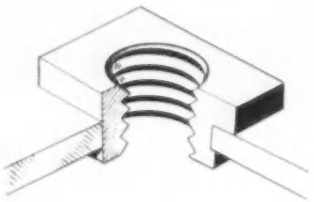
SIX-CYLINDER KROMHOUT DIESEL ENGINE has 36 years of evolution behind it. New 1956 version is immediately below, by D. Goedkoop, Jr. First version of this engine, dated 1922 had separate, clearly articulated cylinder units.





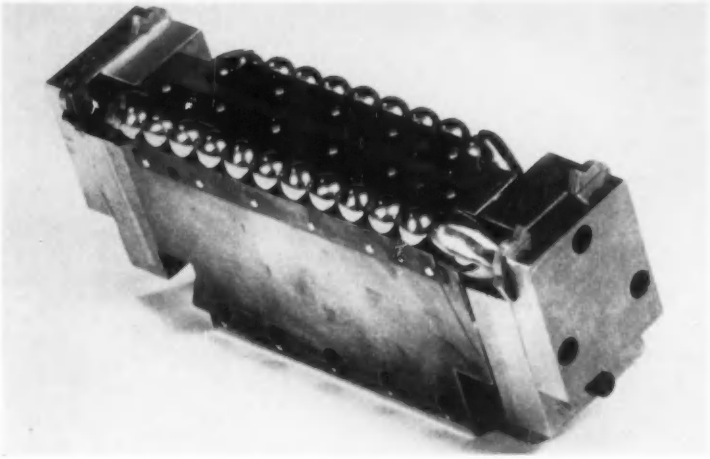
SIGNIFICANT PARTS





Nut that punches its own hole . . .

then seals itself permanently has been released for general short-run applications—formerly, it was restricted to automotive applications because of tooling limitations. Entire operation is accomplished in single stroke of an automatic press, at rates as high as 10,000 an hr. Sheet-metal thickness may range from 0.025 to 0.125 in., and a variety of nuts may be specified. This nut is said to be cost-competitive wherever a multiple-thread fastening is required. Both nuts and tool sets are available from manufacturer. **Fabristeel Products, Inc., 21500 W. Eight Mle Road, Detroit.**

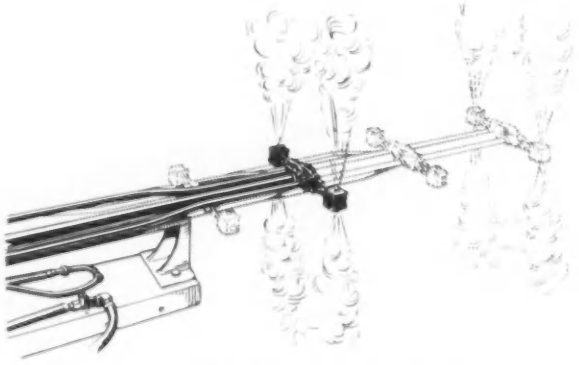


Ball-bearing way cartridges ease traversing . . .

or reciprocating, horizontal motion of heavy machine elements and precision instrument components. Balls are recirculated within cartridges just as they are within nut of ball screws. Capacity and service life are similar to those of standard friction-type ways. Cartridges are attached to moving units, number used and size depends on length and weight. To date, units using balls ¼ to ½ in. dia have been successfully applied. Costs are likely to be somewhat higher than comparable types of construction, but increased production is expected to correct this. Delivery, 8-12 wk after approval of specs. **Beaver Precision Products, Inc., Clawson, Mich.**

Roller-way bearing cuts stick, slip . . .

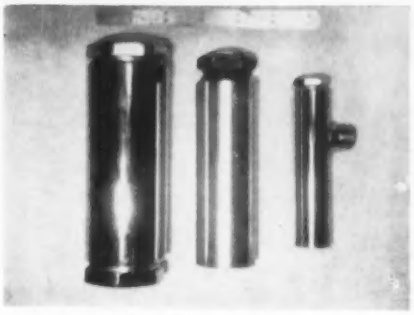
and reduction of feed power while providing unlimited travel, constant accuracy and positive elimination of roller skew. All load-bearing parts use 52100 steel, and bearings are said to be manufactured to close tolerances for use in precision machine tools. The five sizes available range from 3x1 in. to 10½x4 in. width, respective load ratings—2000 to 32,000 lb (5:1 safety factor. Price, $36-130 each; smaller sizes available from stock. **Tycho Mfg. Co., 561 Hillgroove Ave., LaGrange, Ill.**



Sprayer varies position, pattern, density . . .

as it moves backward and forward, spraying at one or more points on either or both motions. Nozzles can be mounted in any number, position or angle, for either intermittent or continuous action. Unit will cycle automatically, or can be made to operate only on manual actuation. Delivery in about 1 wk. Units range in price from $700 to $1000. **Renite Co., P. O. Box 8065, Columbus 1, Ohio.**

MATERIALS · EQUIPMENT



Free poppet valve multiplies air pressure . . .

by changing steady air-line pressure to pulses having about 20 times greater kinetic energy. Valve consists primarily of a cylinder with annular grooves and holes that cause valve to open and shut 2000 to 5000 times per min, in direct ratio to pressure drop in air line. Application to cleaning, lubricating, and kinetic energy devices is expected, though value was originally designed for air tools. Capacity is from 2 to 300 cfm, at 100 psig. Pressure range is 20 to 500 psig. Delivery from stock. Valves cost from $25 to $250, FOB Allentown, depending on size and specifications. **L. C. Nesham Co., P. O. Box 641, Allentown, Penna.**

Roll coverings replaced or repaired by segments . . .

are applicable to finishing, conveying, processing equipment. When wear or damage occurs, only affected segments need be replaced. It is claimed that more durable and more intricate surfaces can be produced, because segment coverings are molded. Sections for the 8-in. contact roll, 1 in. wide x 8½ in. finished OD, are available at $2.00 each. **Chicago Rubber Co., Inc., Waukegan, Ill.**

Stretch cables . . .

in one, two, three conductor types expand 200% and retract. Photo shows a single conductor of 2-amp capacity with a resistance of 0.18 ohm. Relaxed, it is 1 in.; extended, it is over 3 ins. Can be constructed with specific extension limits, in the required number of conductors to meet required current capacity. Terminations are in spade, clip, probe or round. In bulk, up to 1500 ft, 100 ft relaxed rolls of one-conductor nylon-jacketed cable are $16; in silicone rubber and neoprene, $18. Two and three conductor cables are twice and triple the single-conductor price. With terminations, cable is 25% above bulk price. Delivery in 2 to 3 wk. **Stretch Wire Corp., P.O. Box 893, New Rochelle, N. Y**

Programming circuit . . .

provides a simple, automatic control of rate and/or magnitude of change of a variable. It can be applied to any variable that can be measured electrically. Variable is motor current, expressed in ac. And heart of the circuit is a differential meter-relay with two moving coils and two adjustable pointers. Polarity of the coils is such that the single indicating pointer shows the sum of the signals passing through the two coils. Sum remains constant so that if one signal decreases, the other increases. Meter-relay signal is absolute and direct, without the distortion or drift that results from amplification necessary in an electronic hookup. Circuit is sensitive to even a tiny fraction of the signal. Feedback signal, fed directly to the meter-relay, guides control action. It does the same programming job as a closed-loop pulse servomechanism. Prices range from $200 to $500, depending upon control sensitivity and complexity. Delivery in about 5 wk. **Assembly Products, 75 Wilson Mills Rd., Chesterland, Ohio.**

High-temperature compound . . .

of long-fiber, glass-filled diallyl phthalate, possesses flexural strength of 6700 psi. Compressive strength is 6500 psi; tensile strength, 4270 psi at 500 F. A second, short-fiber, glass-filled compound, has flexural strength of 2000 psi, compressive strength of 6000 psi and a tensile strength of 4500 psi at 500 F. Both are considerably stronger at 300 F, up to five times stronger at 80 F. Electrical and chemical properties are reported to be excellent. Materials do not give off corrosive vapors and are meeting applicable military specs. Easy to mold with conventional presses, temperatures, and dies. For use in potentiometers, switches, connectors and other electrical components. In full production, materials are priced at $1.75 a lb for long-fiber and $2.75 for short-fiber compound. Immedate delivery. **Mesa Plastics Co., 11751 Mississippi Ave., Los Angeles 25.**

Exposed contact switches are explosion proof and...

have max spark energy so low that it will not ignite flammable gases, dusts or other materials. Switches, said to be efficient and unbulky, are connected with a control unit that may be located as much as 1000 ft away. Switches are approved for Class I, all groups, of hazardous atmospheres. Price is $180; delivery in about 2 wk. **Brookdale Engineering & Services Co., 6 Beacon St., Boston 8.**

Switch with contacts in arc-quenching gas . . .

is hermetically sealed. Contacts are tungsten and mercury, which makes sticking points impossible. It has no tilting, rotating or mercury level-raising devices. Through use of one or more of these switches, any contact arrangement can be provided. Length is 5½ in. and dia 1½ in. Normally open or normally closed SPST contact arrangement. Max rating is 3 KVA. Speed is 100 contact per min. Price, in nominal quantities, $9.90. Delivery of sample lots within 1 mo. **Energy Kontrols, Geneva, Ill.**

A "bosun" showed us where we were missing the boat

We were just wrapping up a Personnel-Relations meeting when the head of Marine Transportation spoke up. "A crewman aboard the *Melissa* wants to have U.S. Savings Bonds deducted from his pay. Can do?"

It was a significant question. If one employee didn't know he could buy Savings Bonds automatically through our Payroll Savings Plan, there were likely to be others. We planned a course of action.

And we did it the easy way.

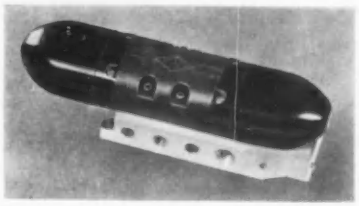
We got in contact with our State Savings Bond Director. He suggested ideas for promoting the Payroll Savings Plan and provided the necessary materials—pay envelope stuffers, posters, leaflets . . . the works. And he made sure everyone received an application card.

Our employee participation rocketed. We never realized how many of our people wanted the security of U.S. Savings Bonds. The Payroll Savings Plan makes it so easy for them to salt a little away, and it's so simple to make it available.

Today there are more Payroll savers than ever before in peace time. Look your State Director up in the phone book or write: Savings Bonds Division, U.S. Treasury Dept., Washington, D.C.

PRODUCT ENGINEERING

THE U.S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR ABOVE



Multipurpose control valve . . .

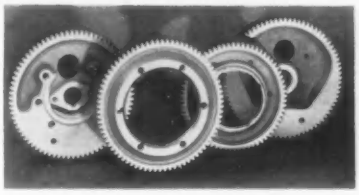
requires no packings and offers plug-in design of all elements as standard equipment. Available in single and double-solenoid models, the directional valve can be operated to 1000 psi and the same basic unit can be used for air, water or oil. Assembly contains full ¼-in. passages and can be supplied with ¼, ⅜ or ½-in. pipe ports. Direct-acting solenoid used to actuate the valve has been miniaturized to reduce inrush current and pounding of solenoid. Sub-base mounting of the valve features permanently imbedded wiring and a junction box with conduit connection. **Alkon Products Corp., 200 Central Ave., Hawthorne, N. J.**

One-way torque bearings . . .

for positive control of angular shaft position prevent independent movement of a driven shaft except when rotation is produced by a drive shaft. Both shafts insert in bearing assembly. Two conventional double-row ball bearings, with extended inner rings, are used on either end. Between the two is a lock ring, containing a spring-loaded lock bar. Driveshaft rotation compresses spring and releases lock bar. This permits rotation to be transmitted to driven shaft. However, independent driven shaft movement will wedge lock bar against fixed outer lock ring. Driven member play is less than 2°; drive shaft play is less than 4.5°. Standard torque ratings range from 50 in.-lb to 2600 in.-lb. **Ann Arbor Bearing & Mfg. Co., 815 Wildt St., Ann Arbor, Mich.**

Teflon-coated O-ring . . .

seals effectively at temperatures to −300 F. Metal base eliminates cold flow of most Teflon O-rings when subjected to high pressures. Available in all standard metal O-ring sizes and can be used in grooves designed for plain metal O-rings. **Advanced Products Co., 59 Broadway, North Haven, Conn.**



High-strength malleable iron . . .

couples wear resistance with good machining characteristics. Developed for cast gears and other parts. Parts shipped from the foundry do not require additional heat treatment. Tensile strength is 105,000 psi, min yield 85,000 psi and min elongation 2% in 2 in. The casting material has hardness rating of 269-302 Bhn. Surface hardening, when needed, can be obtained by flame hardening, induction hardening or by immersion. Casts well in green sand or shell molds. Originally developed for the automobile industry, material has been tested in applications previously requiring carburized steel forgings. **Central Foundry Div., General Motors Corp., Saginaw, Mich.**

Miniature dc brake . . .

is now available on 1.675 in. dia motor providing up to 10 in.-oz of holding torque when deenergized. Motor can be hysteresis, synchronous or induction type for 60 or 400 cps operation. Brake winding and adjustment can be set up for various line voltages and operating conditions. Brings total length for standard unit to 3¼ in. Weight is about 5¼ oz. High torque rating of motor and fast-stopping and holding torque of brake makes it applicable to actuator applications. **Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.**

Battery-driven clock . . .

is guaranteed to run automatically for 2 yr without winding or charging of battery. Has been designed for remote field stations when manual or photographic recording of data is required. Waterproof, chemical resistant and finished to military specs. **PIC Design Corp., 477 Atlantic Ave., East Rockaway, N. Y.**

Air-operated pumps . . .

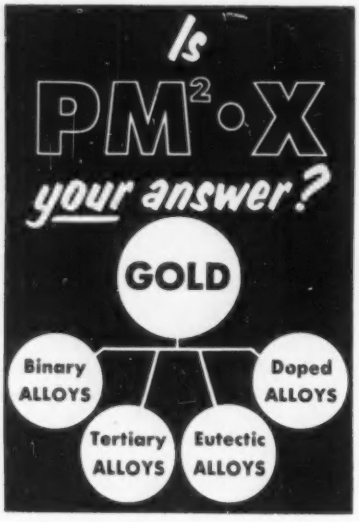
are for high-pressure testing or powering of equipment, using oil or water. Available in nine sizes, capable of producing from 500 to 25,000 psi hydraulic pressure from a max of 100 psi air pressure. When the pump is incorporated into a circuit that provides automatic control, it will maintain required pressure indefinitely, operating only often enough to replace any fluid required by the job or lost through leakage. Pump cannot stall; whenever it is idle, air-piston actuating valve is automatically positioned on power stroke. **SC Hydraulic Engineering Corp., 6318 Central Ave., Los Angeles 1.**

Short-length servo motors . . .

with high torque-to-inertia ratio are available with inputs from 6 to 57 v. Length is 1.062 in. and dia 0.750 in. Units operate within ambient temperatures of −67 to 257 F. Size 8 servo motors have max power output of 0.45 w. Frequency is 400 cps. Stall torque is 0.30 oz. The motor weight 1.6 oz. **Induction Motors Corp., 570 Main St., Westbury, N. Y.**

Miniature gear head . . .

is 1.437 in. dia and 1.093 in. long. A multiplicity of ratios from 15:1 to 4300:1 are obtainable to handle loads to 50 in.-oz and momentary loads to 100 in.-oz. Gears are completely enclosed. Backlash is held to 30 min with a 5 in.-oz reversing load. Axial play is limited to 0.003 in. with a load of 1 lb applied to output shaft. Radial play is not greater than 0.002 in. per in. of length when 4 in.-oz load is applied. **Daco Instrument Co., Tillary and Prince Sts., Brooklyn 1, N. Y.**



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Growing complexity of requirements in the electronic and atomic fields brings demand for gold coatings that have qualities other than 24K gold. Technic methods and equipment enable you to meet problems with a new tool — an exact metallurgy which alloys 24K plating gold with trace amounts, or more, of desired elements.

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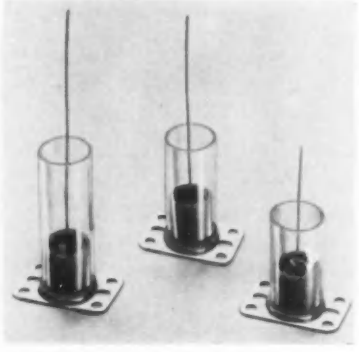
SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

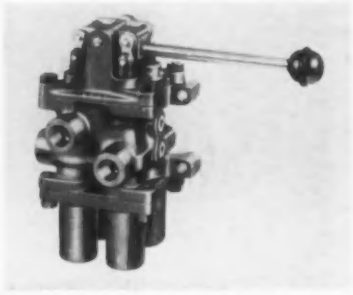
Self-aligning bearing . . .

eliminates backlash and features an interlocking race with 100% contact between race and ball, with tolerances as close as 0.0002 in. Can be supplied in any metal that can be machined. Interlocking race, in which both halves extend slightly beyond center, forms a complete mass when assembled. A patented plating process on the inner race provides self-lubricating qualities. **Fuller Tool Co., 4000 Eleven Mile Rd., Berkley, Mich.**



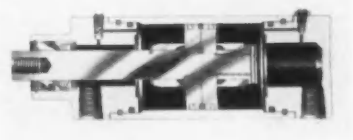
Air-damping dashpots . . .

for system stabilization, vibration damping and time delay are available with one-way or two-way action in either direction. Two-way models provide adjustable damping, equal in both directions; one-way models offer nonlinear adjustable damping in the push or pull direction and fast reset. Calibration is maintained with reliability comparable to that of a conservatively loaded spring or mechanical linkage. Damping constant is adjustable to 2 lb per in. per sec. Max tension force is 4 lb at sea-level. Temperature range is from −107 to 302 F, weight: less than 1 oz. Available in various cylinder lengths and connecting-rod spring gradients of 6.6, 10, 20 and 200 in.-lb. **Electric Regulator Corp., Pearl St., Norwalk, Conn.**



Lever-operated neutral valve . . .

is suitable for use with raw cold water, oil or glycol-base fluids. Widely used where tight sealing and leak-free operation are required. Available in ½ in. NPT, 1000 psi, three and four-way models. All ports are closed in the neutral position. Valves have hand-lapped metal-to-metal seats, bronze bodies and stainless steel stems and seats. Molded rubber packers provide tight sealing. Three $\frac{7}{16}$-in. mounting holes are provided. **Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11, Ohio.**



High-temperature cylinders . . .

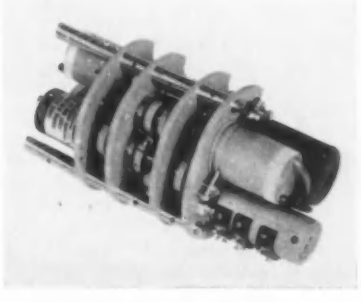
for standard air and hydraulic service permit continuous, elevated-temperature operation from −20 to 500 F. Design centers around high-temperature packings and lubricants. Greasing is located in grooves adjacent to packing areas. Pressure service rating for air cylinders is to 150 psi and for hydraulics to 350 psi. Size range for standard units is 1½ to 8 in. bore with stroke lengths to 18 ft. Cushioned and noncushioned models are available. Cylinder wall and heads are joined by a key-type stainless steel locking ring that permits 360° rotation of pipe parts. Piston incorporates two low breakout, double-acting piston rings with an O-ring between. All standard mountings available. **Carter Controls, Inc., 2800 Bernice Rd., Lansing, Ill.**

Cement sampler kit . . .

contains 14 different types of special cements for experimentation. Cements offer solutions to a wide assortment of surface joining problems. Each bottle has its own applicator and all cements are available in larger containers up to 55-gal drums. Kit is $9.95 list. **General Cement Mfg. Co., Adhesive Div., 400 S. Wyman St., Rockford, Ill.**

Static-magnetic control annunciator . . .

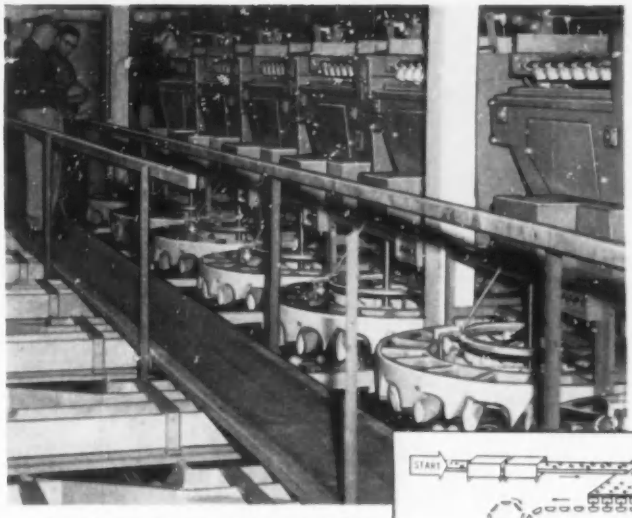
operates without relays, to monitor complex automatic systems. It visually and aurally reports off-normal occurrences on an instrument-type panel. Controls have no moving parts and provide a high degree of reliability for monitoring critical operations or conditions. Plug-in design makes it possible to change sequences without rewiring or to expand the system, if necessary. Elements are capable of AND, NOT, OR and MEMORY functions. In case of power failure, it will remember its previous state after power has been restored. Particularly applicable to industrial systems where interlock or automatic shutdown are involved. **Panellit, Inc., 7401 N. Hamlin, Skokie, Ill.**



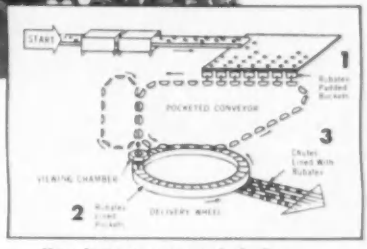
Servo components . . .

may be assembled from stocked parts. A typical unit would probably consist of six rotating-shaft components, 2⅛ in. dia, and is available in almost unlimited gearing and component configurations. Stocked components include miniature clamp-on gears, antibacklash gears, pin couplings and slip clutches. In conjunction with a predesigned ball-bearing gear-plate assembly and 0.125-in.-dia shafts of various standard lengths, they provide a versatile gear box with as many as six shaft extensions on either side. Enclosures are available in hermetically sealed and dust-tight designs with plug-in or AN connectors. **Precision Mechanisms Corp., 577 Newbridge Ave., East Meadow, N. Y.**

Rubatex cushions dropping of over a million lemons a day in electronic color-sorting machine



Versatile Rubatex (stock R-411-N) used as a bumper guard for washing machines, vibration isolator and dust seal for control instrument panels and oil resistant gaskets for radar, automotive and aircraft industries —now plays an important part as cushion padding in the electronic color-sorting machine of Electric Sorting Machine Company, Division of Mandrel Industries, Inc., Houston, Texas.



How lemons are graded—by color—electronically

Over a million lemons a day are protected from bruise . . . (**1**) when unsorted lemons are dropped seven at a time into Rubatex-padded buckets attached to endless chains which carry lemons on to viewing chamber . . . (**2**) where, after color decision, they again fall into Rubatex-lined pockets of delivery wheel . . . (**3**) and later are dropped onto a Rubatex-lined conveyor which moves on to crating area.

Whenever you have a problem of sealing, cushioning, or vibration isolation—be sure to check the advantages of Rubatex Closed Cellular Neoprene first!

RUBATEX
CLOSED CELLULAR NEOPRENE

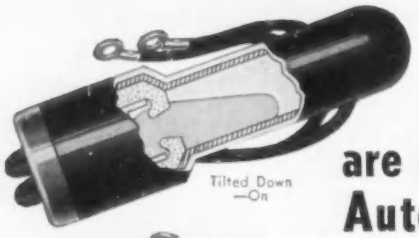
RUBATEX DIVISION, Dept. PR-12
GREAT AMERICAN INDUSTRIES, INC.
Bedford, Virginia

PIONEER MANUFACTURER OF CLOSED CELLULAR RUBBER

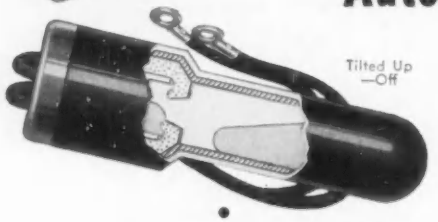
Just fill out and mail for free sample and more information about Rubatex Closed Cellular Neoprene.

Name

Send for Free Sample and Data Sheets



DURAKOOL Tilt Switches are the Life of your Automatic Controls



This steel-clad Durakool mercury tilt switch has unique construction features that deliver years of trouble-free performance on the most difficult assignments you can find. Operating under sealed-in, pressurized hydrogen gas, it takes 24 hours, fast cycling schedules in stride. 7 sizes, 1 to 65 amperes. Send for Bulletin 525.

MILLIONS OF CYCLES WITHOUT FALTERING

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DURAKOOL, INC.
ELKHART, INDIANA, U.S.A.
700 WESTON RD., TORONTO 9, CANADA

Durakool ALL-STEEL MERCURY *Switches*

design engineers!

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PORCELAIN ENAMEL

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Liquids
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} WITHOUT CORROSION or CONTAMINATION

Forces Material Through Tubing

Capacities 0.2 cc. per min. to 4.5 G.P.M.

Prices range from..... $60.00 to
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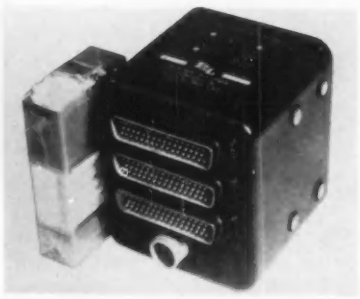
31 North Main St. • Middleport, N.Y.

SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

Microminiature relays . . .

are said to have long life at high temperatures. Current-sensitive and voltage-sensitive models are offered. Withstand shocks of 50 g and vibration to 200 cps at 20 g. Contacts are DPDT or SPDT, rated at 2 amp resistive, 28 v dc or 115 v ac. Operates continuously in temperatures of −85 to 257 F. Current-sensitive model requires a nominal operating power of 135 milliw for the single-pole version and 200 milliw for the double-pole. Models conform to or exceed military specs. Hermetically sealed relays weigh fraction of an ounce. **Iron Fireman Electronics Div., 2838 SE 9th Ave., Portland 2, Ore.**

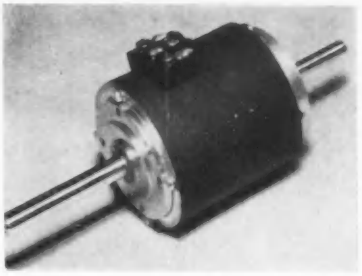


Subminiature sampling switch . . .

has been designed in a package that results in a 50% reduction in over-all volume for a given number of circuits. In this unit, the 400 cps, 115 v, single-phase drive motor is contained inside commutating rings. An integral gear box drives three poles with 45 contacts at 20 rps. Hermetically sealed; weight, about 3 lb; size, 3¼ x 3¼ 3⅞ in. Provides high and low-level bounce, free-contact operation. **Instrument Development Laboratories, Inc., 67 Mechanic St., Attleboro, Mass.**

Packaged servo component . . .

consists of an integral combination of a two-phase instrument servo motor, gear reduction, slip clutch and potentiometer. Offers precision servo performance in a modular construction. Built-in slip clutch is factory-adjusted to permit servo operation into potentiometer stops without damage. Standard potentiometers feature 0.5% linearity and are available with resistances from 35 to 80,000 ohm. Single, multiturn and nonlinear models are available. Addition of an integrally mounted ac tachometer with 0.5% linearity provides a complete integrating servo. **Diehl Mfg. Co., Finderne Plant, Somerville, N. J.**



Miniature clutch-brake . . .

combines a magnetically set clutch with a spring-set brake. Torque range of the clutch is 100 in.-oz; torque of the brake is 8 in.-oz. Designed for fast engagement and release. Complete with drive and driven shafts. Entire unit weighs 15¼ oz and can be wound for any dc voltage up to and including 28 v. **Stearns Electric Corp., 120 N. Broadway, Milwaukee 2.**

Subminiature photoelectric cells . . .

are ⅞ in. long; miniature units are 1½ in. long. Designed for use with the company's regular control relay and other relays that provide modulation of both light strength and photo-unit sensitivity, giving precise triggering of light differences both by transmitted or reflected light. Units have been adapted to compatible circuitry providing similar precise control. **ESS Instrument Co., Dept. M, 96 S. Washington Ave., Bergenfield, N. J.**

Photographic paper . . .

makes possible high-contrast enlargements from microfilm negatives. New paper is expected to expedite retrieval of engineering drawings that have been stored on microfilm. May be used to make translucent, vellum-type reproductions of tracing for immediate use or for production of multiple prints on a direct-process machine. New emulsion produces dense, black lines for intermediates. Available this month. **Eastman Kodak Co., Rochester 4, N. Y.**

Hydraulic governor . . .

is for variable or constant-speed service, using engine lube oil as the pressure medium at min input pressure of 5 psig. Controls speed of gasoline or diesel generator sets, engine-driven compressors, engine-driven arc welders, marine engines, trucks, tractors and similar equipment. Unit provides immediate response to load change and will regulate within ±1% steady-state operation. Work capacity is 12 in.-lb with an optimum operating speed of 2400 rpm. Over-all height is 6¼ in.; weight is 10½ lb. **Farris Pickering Governor Co., Inc., 705 Commercial Ave., Pallisades Park, N. J.**

THE SHAPE OF THINGS IN MOLDED RUBBER

MOLDED LIFE GUARD
KEEPS SWITCHES FROM DROWNING

APPLICATION:

Water seal for push button switches on top brand washing machine.

PROBLEM:

Compound a rubber stock that will provide a molded part with good electrical resistance and be able to withstand deteriorating action of soap and detergents. Produce a molded part that would effectively seal push buttons from water without restricting switch movement.

SOLUTION:

The small openings for switch buttons posed a very definite problem. The contours of openings had to allow buttons to move freely and at the same time provide a perfect seal (shown in close-up). Acushnet laboratory technicians first produced a dipped part to experiment with the flash of rubber around the switch area. Natural rubber was selected for maximum flexibility and to provide excellent hot tear resistance, an essential quality in the molding of this special part. For the sake of economy a compression mold of sintered metal with a solid steel core made possible a flash extension fit of .050" resulting in a precision fit over the switch buttons after the dieing out finishing process. This mold, designed and built by Acushnet, aided in economically producing a high quality part that passed the Underwriter's Laboratory tests.

Acushnet's exclusive facilities for accurate compounding, engineering and precision molding of rubber, silicone and silicone resin parts can aid you with your next problem at any stage of design.

Send for Acushnet "Rubber Data Handbook."

What's Your Shape?

Acushnet

ACUSHNET PROCESS COMPANY

NEW BEDFORD, MASSACHUSETTS

... *Precision Molded* **RUBBER, SILICONES - "APCOTITE" BONDING**

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What is—

"MOLDED FIBER GLASS"?

It's fiberglass reinforced plastic, custom molded by the affiliated MOLDED FIBER GLASS Companies.

It's one of the strongest, most durable materials known — a formulation of glass fibers and polyester resin possessing many superior physical features and infinite design possibilities.

When skillfully molded by the exclusive MOLDED FIBER GLASS process (using made-to-fit preforms and matched metal dies), it forms products which do the job **better**, last longer, and are often more economical to produce.

The affiliated MOLDED FIBER GLASS Companies are pioneers in and world's largest producers of mass-produced fiberglass reinforced plastic parts.

If you are looking for ways to make a better product, at less cost — investigate MOLDED FIBER GLASS. Consultation with MOLDED FIBER GLASS engineers entails no cost or obligation. Write for new engineering handbook.

Beautiful, rust and corrosion-resistant planters

Strong, lightweight business machine housings

Molded Fiber Glass horns address the world

Molded Fiber Glass Company

4423 Benefit Avenue, Ashtabula, Ohio

MAR.

IRE National Convention and Radio Engineering Show, Waldorf-Astoria Hotel and New York Coliseum. Program includes 275 papers covering fields of all 27 IRE professional groups. 850 exhibitors are participating in the show. For information contact E. K. Gannett, 1 East 79th St., NYC.
24-27

American Power Conference sponsored by Illinois Institute of Technology, 35 West 33rd St., Chicago, in cooperation with 14 other colleges at Hotel Sherman, Chicago. A program of 90 papers will cover various aspects of the electrical power industry including a progress report on nuclear developments.
26-28

Society of the Plastics Industry, 15th Annual Pacific Coast Section Conference, at El Mirador Hotel, Palm Springs, Calif. For information contact the Society, 250 Park Ave., NYC.
26-28

American Institute of Electrical Engineers, Southwest District Meeting at Mayo Hotel, Tulsa, Okla. The 14 technical sessions will cover advances in systems engineering, engineering education, aircraft, power distribution, transmission and communication. For information contact the Institute, 33 West 39th St., NYC.
31-April 2

APR.

ASME Instruments and Regulators Division, 4th annual conference with participation by AIEE, IRE, ISA, and AIChE at University of Delaware, Wilmington. Four technical sessions and a panel discussion will be supplemented by plant visits. For information contact L. Bertrand, Engineering Service Div., Louviers Building, E. I. Du Pont de Nemours, Newark, Del.
2-4

SAE National Aeronautic Meeting, Aeronautical Production Forum and Aircraft Engineering Display, Hotel Commodore, NYC.
8-11

ASME Design Engineering Conference and Design Engineering Show, International Amphitheater, Chicago. For information on the conference contact ASME, 29 West 39th St., NYC. For information on the show contact Clapp & Poliak, Inc., 341 Madison Ave., N. Y. 17, N. Y.
14-17

American Zinc Institute, 40th Annual Meeting, Chase-Park Plaza Hotels, St. Louis, Mo. Sessions will cover technical research, supply and demand, and market development of zinc. For information contact the Institute, 60 E. 42nd St., NYC.
14-15

9th Rubber and Plastics Conference, sponsored by American Institute of Electrical Engineers, Sheraton Mayflower Hotel, Akron, Ohio. Sessions will cover analysis of Russian education as well as technical problems. For information contact the Institute, 36 West 46th St., NYC.
14-15

National Open Hearth Steel Conference, 41st annual meeting, sponsored by National Open Hearth Steel Committee of the American institute of Mining, Metallurgical and Petroleum Engineers, Statler Hotel, Cleveland, Ohio. Papers will cover analyses of steel defects, design maintenance and operation of two-pass checkers and fundamental aspects of oxygen in steelmaking. For information contact the Institute, 29 W. 39th St., NYC.
14-16

Lead Industries Association, 30th Annual Meeting, Chase-Park Plaza Hotels, St. Louis, Mo. Sessions will cover new uses for lead, reports of divisional activities and committees. For information contact the Association, 60 E. 42nd St., NYC.
15-16

Annual Welding Show, American Welding Society and ASME, Kiel Auditorium and Hotel Statler, St. Louis. About 125 companies will conduct product demonstrations. For Information contact AWS Welding Show, c/o Robert Kenworthy, 12 East 41st St., NYC.
15-17

Institute of Environmental Engineers, Annual Meeting, Hotel New Yorker, NYC. Sessions will cover role of environment science in satellite program, and operation deep freeze in the Anarctica. For information contact the Institute, 9 Spring St., Princeton.
17-18

NEW LITERATURE

Blast Off!

* L. J. Carter; *published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 6x8¾, 431 pp, $7.50.*
** *Published by E. P. Dutton & Co., 300 Fourth Ave., New York 10. 6¾x9¾, 290 pp, $6.95.*

Books on *"Realities of Space Travel"** and *"Space Encyclopedia"*** would seem very timely, but unfortunately there is little in either of these books that could not have been published years ago. "Realities" is mainly a collection of papers on space vehicles, interplanetary flight problems, physical and medical considerations and similar topics. Two of the papers were published as long ago as 1948; none of them no more recently than 1955. To dub such a book *"Realities of Space Travel"* is about as realistic as it is premature.

The same wishful titling applies to the encyclopedia. Information on guided missiles, satellites, most branches of astronomy and space medicine is provided, but not in enough detail to give a scientific understanding of the principles involved. For example, in defining "escape velocity," no mention is made of the fundamental-energy equations involved in computing the speed required to escape Earth's gravitational force.

However, both of these books may prove useful as background reading and as references to the reader interested in broadening his understanding. NC-JK

Dangerous Properties of Industrial Materials

N. Irving Sax. *Published by Reinhold Publishing Corp., 430 Park Ave., New York 22. 10¼x7¾, 1500 pp. $22.50.*

The engineer who, unknowingly, specifies a material that is potentially dangerous to workers in his own plant, or that falls within special government precautionary labeling regulations, may be heading for plenty of trouble. This "monumental" 1467-pp book can help head it off. It's got the data on 8500 materials (3500 more than in previous editions). Its tremendous size, though, poses a problem. It is to be hoped that the next edition will be in two sections. ARG

Control in Man-machine Systems

Abstracted from "Control in Man-machine Systems," by G. W. Hoover, Office of Naval Research, Control Engineering, *March 1958, 330 W. 42nd St., New York 36.*

The author maintains there is no system in which man does not exercise control, if only during startup periods. Because of this, first step after setting system objectives is to determine types of information to be displayed—as well as methods of displaying data. Specs for sensors, manual-control loops, automatic-control loops then become functions of the given system's display requirements.

Industrial Chemicals

W. L. Faith, Donald B. Keyes, Ronald L. Clark. *Published by John Wiley & Sons, 440 Fourth Ave., New York 16. 9½x6¼, 844 pp. $16.*

This is a second edition—much improved and expanded. It covers just about everything an engineer needs to know about the production, price, important properties and applications of 140 of the most important industrial chemicals produced in this country—among them, alcohols and acetylene compounds, glycerine, and the mineral acids. ARG

Photo Methods for Industry

This new monthly magazine, called "PMI," is intended for photographers in industry. It is technical, details techniques, covers all types of photography and all types of photos for industrial use. Further information from *Everett Gelbert, publisher, 33 W. 60th St., New York 23.*

STAMPING OF SUBMINIATURE PARTS—Brochure, 4 pp, shows many parts formed to meet rigid tolerances for special instrument and electronic purposes. It describes methods used and special equipment and facilities available for manufacturing, inspecting, testing. Be Cu Mfg. Co., Inc., 40 Kent St., Newark, N. J.

SILICONE DIELECTRICS—Brochure, 12 pp, outlines properties of silicones as dielectric materials. Also discusses the use of silicone rubbers, fluids, resins and compounds in applications ranging from electric-motor insulation to electronic control systems. Scope includes molded parts, rigid or resilient, laminates, tapes, flexible and rigid sheeting, surface coatings, wire coverings, fillers, impregnants, sealers and encapsulating compounds. Lab data is presented, backed by field applications for each physical form of silicone discussed. Dow Corning Corp., Midland, Mich.

DESIGN, CONSTRUCTIION OF MODELS—Brochure, 8 pp, describes services and facilities for design, development, fabrication of industrial models, mock-ups and prototypes. PDD Corp., 379 Market St., E. Paterson, N. J.

ELECTRICAL AND ELECTRONIC ASSEMBLIES—Brochure, 12 pp, outlines resources, physical facilities, experience for development and production of electronic and electromechanical products and assemblies. Includes a brief history of company, short biographies of key personnel, illustrated descriptions of facilities and illustrated examples of typical technical and commercial products. Gray Mfg. Co., Industrial Div., 16 Arbor St., Hartford, Conn.

MAGNESIUM ALLOYS—Booklet, 54 pp, describes properties, uses of magnesium. Gives specs on machineability, weight, weldability, design, strength, durability and bulk stiffness. Also included is information on aluminum alloys and products. White Metal Rolling & Stamping Corp., 88 Moultrie St., Brooklyn 22, N. Y.

ZINC-BASE ALLOYS—Booklet, 24 pp, contains properties and ASTM and SAE specs on most popular alloys. Henning Bros. & Smith, Inc., 91-127 Scott Ave., Brooklyn, N. Y.

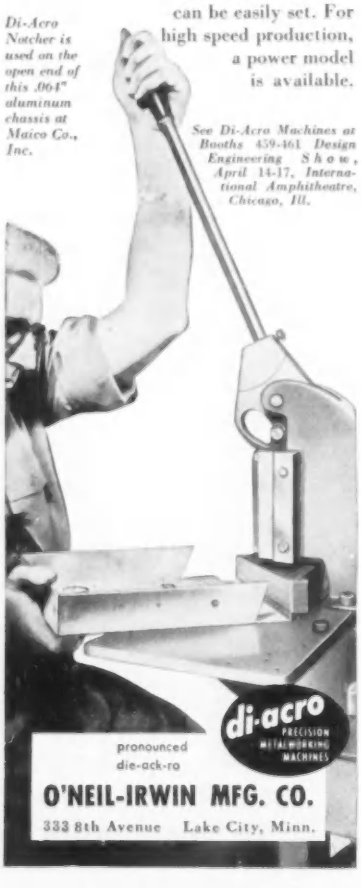
DI-ACRO NOTCHER
Speeds Production, Saves Extra Operations on Chassis Work

"I use our Di-Acro Notcher for practically everything," says V. Johnson of Maico Co., Inc., Minneapolis manufacturer of hearing testing equipment. "This machine speeds production—*provides one operation notching* of cold rolled steel, brass, phosphorous bronze and aluminum up to 16 gauge thick. It's also used for notching fish paper, sponge rubber, 1/16" linen Bakelite and other circuit insulating materials that go into chassis for audio testing equipment."

The 4 ton pressure of this machine has the capacity to cut a 90° notch as large as 6"x6" in 16 gauge steel *in one operation*. Adjustable gauges mounted on work table are standard. Hardened and ground triangular ram assures years of precision. A clean cut, free from rough edges and burrs, is possible because blade clearance can be easily set. For high speed production, a power model is available.

Di-Acro Notcher is used on the open end of this .064" aluminum chassis at Maico Co., Inc.

See Di-Acro Machines at Booths 459-461 Design Engineering Show, April 14-17, International Amphitheatre, Chicago, Ill.



Publisher's Postscript...

WHERE ARE WE HEADING?

Ever since the termination of World War II, the growth of the Metalworking industries has outstripped that of American Industry as a whole. This spectacular growth can be attributed in a large measure to the vast number of new designs of machinery, equipment, appliances and transportation equipment this dynamic industry has developed and aggressively sold.

Likewise, Metalworking's vast expansion in production facilities contributed much to our prosperity in recent years. Since 1953, the capital invested in enlarged plant capacity increased each year from roughly $3 billion to $4.7 billion in 1956. 1957 total investment in new plants started to show a slight decline to $4.5 billion. Undoubtedly, we have built faster than we can absorb the increased output, for expenditures in 1958 for new or enlarged plants are expected to decrease to $3.7 billion, but will rise again in 1959 to reach an estimated $4.8 billion in 1960.

While appraising the plant-facilities picture, it is interesting to note that the trend of expenditures for product research and development continue upward on almost a straight line. From an expenditure of $2.4 billion in 1953, the investment in R & D by metal-product manufacturers has shown a steady increase year after year, reaching a total estimated investment of $5.3 billion in 1957, and a projected expenditure of $5.7 billion for 1958—rising to an estimated $6.9 billion by 1960.

Prior to 1957, Metalworking put more money into plant expansion than into research and product development. But in 1957 the trend reversed. R & D investment exceeded the amount put into new plants by $800 million. In 1958, this increase should swell to almost $2 billion more for R & D than for plants.

Product design, research and development will continue their forward march without the cutbacks currently plaguing many production and plant-expansion operations. Best estimates are for an expenditure of $4.8 billion for plant expansion in 1960, while R & D expenditures for that year should come close to $7 billion.

Product design, research and development has become the most dynamic function throughout the Metalworking industries. At no time in our industrial growth has there been a greater need for new ideas and new ways of achieving end results. Our future growth, industrially, will depend more and more on the imagination, the ingenuity, and the practical thinking of the men who develop and design our new products.

Our associate publication, *American Machinist* (McGraw-Hill's magazine of Metalworking Production), recently published a 12-page Special Report on "Where Metalworking is Heading." It contains 20 graphs and charts in color of never-before-published figures on plant capacity, production, research and development, and capital spending in the major segments of the Metalworking industries. The report covers the period 1953 to 1957, with projections to 1960. If you'd like a copy, just drop a note to Catherine Kane, PRODUCT ENGINEERING's Reader Service Manager, McGraw-Hill Building, New York 36, and ask for "Where Metalworking is Heading." I'm sure you'll be impressed with the brilliant future it portrays for our dynamic field of Product Design, Research and Development. —AH

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74 For Your Information (personal)

En garde

A simple and relatively inexpensive proximity device (no photocells or extra wiring) is ready to guard your home, or set displays and models working as a viewer approaches. The burglar alarm, which can be made to turn on lights, ring bells, or snap a shutter, weighs only 9 lb, can be plugged into a 110-volt ac circuit. It's priced at $195. The display-activating device is even simpler—and less expensive. ($95). Werner Co., 188 West Randolph, Chicago 1, is distributor.

Those ubiquitous sprays

If history records this as the "pushbutton age," the little aerosol cans with the pushbutton tops will have a lot to do with it. Starting with the famous "bug bomb" of World War II, they've now branched out to include everything from shoe-shine lotion to whipped cream. Last year, some 400 million units were produced and sold, and the industry confidently expects to reach half a billion this year. Bringing them to this point, though, has been a real engineering achievement. Hundreds of valve designs were tried before the present types were adopted, and special aerosol containers and propellants had to be developed. In many cases, the products themselves had to be reformulated to permit spraying. That's why it's only now, for instance, that aerosol toothpastes are making their debut (Carter Products' Sno-White is the first). What's next. More dual-purpose sprays like Boyle-Midway's recently introduced Wizard air sanitizer-deodorizer; a host of fluffy, frothy food products; and many industrial coatings and lubricants.

Two-in-one for smoother coats

Synthetic bristles offer many advantages in brushes. But they've never quite been able to equal the hog's output when it comes to smoothing on paint. Now, Pittsburgh Plate Glass Co. believes it has the problem licked by using two synthetic fibers instead of one. Its new "Raylon" line, combining heavy-gage, tapered rayon with flagged nylon bristles, is said to offer "the closest duplication of hog bristle performance of any brush material currently available." Nylon provides strength and abrasion resistance, the rayon improves pickup and holding capacity. The combination is said to cost less than all-nylon and considerably less than hog bristle.

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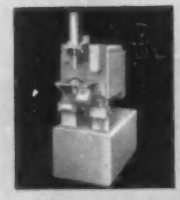

. . . with typical tooling for assembling parts and injecting PERMAWICK into sleeve bearing lubrication cavities . . . in one automatic operation.

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. . . a metal or plastic molding to go along the ceiling or floor of a room—decorative in design and with enclosed wires so that the molding could serve in place of BX or surface raceway channels for simple, additive house wiring? —R. A. Castrignano

. . . windshield cleaners working on the supersonic principle? Energy of the high-frequency vibrations has been found effective for melting ice and vaporizing water. While large gobs of power might be needed, an efficient heat-to-sound energy trans-ducer would work wonders for the driver who has to see his way through inclement weather.

—J. Meyer

. . . a low-cost facsimile machine for home use? Sets could be leased by newspaper publishers to the home owner and the newspaper would then be printed and available without distribution costs or delays.

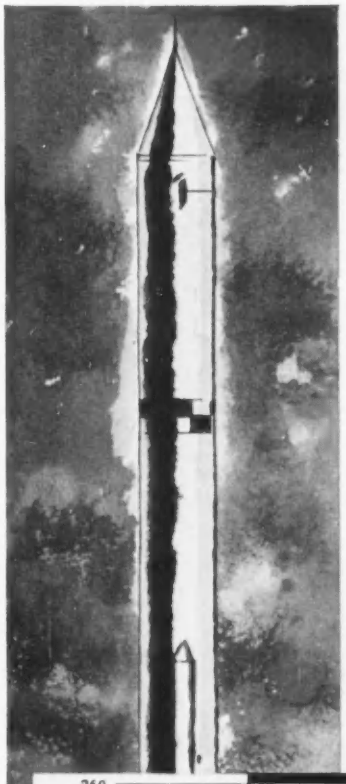
—V. J. Perillo

. . . an ambulance cot that would stay horizontal as the ambulance travels over inclined banks and curves. And how about an arrangement that keeps the cot reasonably level when carried up stairs and down?

—R. C. Gaston

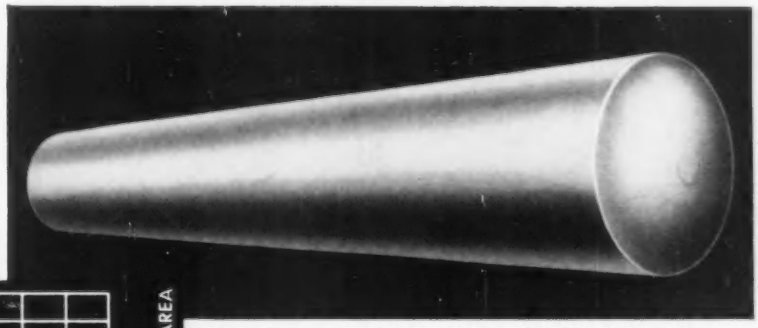
. . . self-service gas pumps? Credit-card customers could drive up, insert the credit card to operate the pump and the pump would issue a receipt after filling. Other vending machines could be operated by the same credit card. The system would reduce the number of service people at stations on turnpikes and super-highways. Where personnel are involved, it would free them to give their full attention to emergency service without interruption. —V. J. Perillo

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

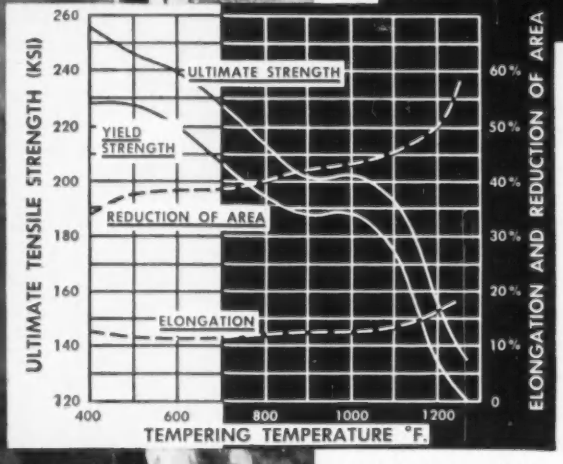


Newest advance in missile tankage

A. O. Smith flash-welded and fusion-welded units have exceptional strength . . . can be furnished in sizes and configurations to meet your designs exactly



Typical missile propellant tank as produced by A. O. Smith. Diameter is 40", length 28'. The highly stressed longitudinal welds in the "roll and weld" fabrication method can be flash-welded for higher strengths.



Materials are available which will produce properties indicated above. Current lightweight, high-strength propellant tanks are being produced in the strength range indicated by the yellow area of the chart.

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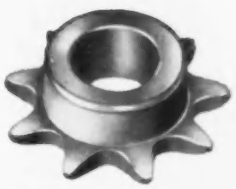
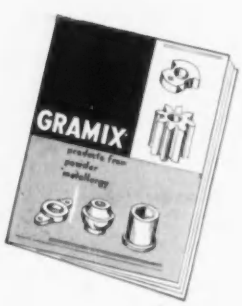


Hardened steel drive sprocket for lawnmower

Iron switch control

Rotor for gasoline pump

Packing gland follower used in hydraulic system



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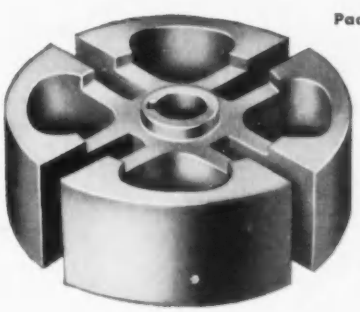

Bronze rotor in high speed fueling unit

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